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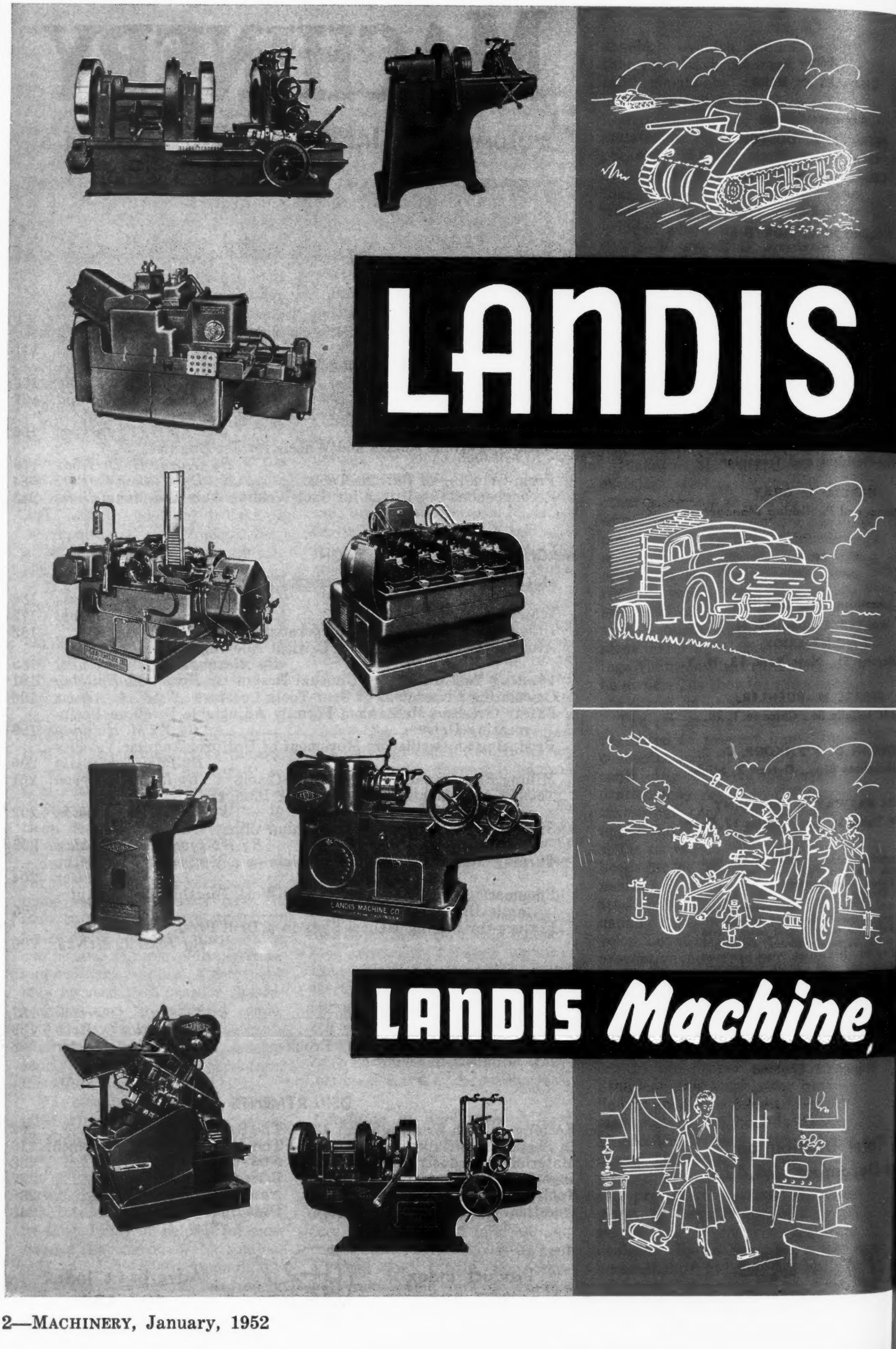
SHOP PRACTICE

MACHINE AND TOOL DESIGN

MANAGEMENT PROBLEMS

DEPARTMENTS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By LORING F. OVERMAN

The Machine Tool Industry Gets the Green Light

WASHINGTON planners are continuing to push frantically on buttons that they hope will result quickly in the production of machine tools at a rate 500 per cent that of the first half of 1950. The moves include scheduling scarce materials for use in the first quarter of 1952 in quantities to support such a production rate; amending Order M-41 to channel the bulk of machine tool production into rated defense-connected orders; issuing a new Order M-41A limiting priorities to buy machine tools; and establishing price concessions reflecting the much-discussed Capehart Amendment formula.

How machine tools rate in the defense program is evident when the 500 per cent over 1950 production rate is compared with a number of other products in the general industrial equipment classification. For example, provision is made for production at a rate 300 per cent that of 1950 for cutting tools, jigs, and fixtures, while a goal of 200 per cent of the 1950 level is set for the production of rolling mill machinery which is closely allied to the steel expansion program. Support is provided for production of welding apparatus at the rate of 175 per cent of 1950 levels.

That the machine tool industry is making admirable gains is evident from production statistics for October. Shipments during the month totalled 220.7 per cent of the 1945-47 average compared with 189.9 per cent in September.

IN addition to setting aside the materials needed to boost production, Washington is making certain that "the right people"—meaning the producers of defense products—get their machines first. NPA's decision to prevent any major retooling by automobile plants or others not working on defense orders was implemented by amended Order M-41 and a new Order M-41A. The former order prevents machine tool builders from accepting non-rated orders calling for deliveries after February 1, 1952. The bar does not apply, however, to machine tool producers whose production on rated orders is below 70 per cent of average production during the first six months of 1950. NPA admits that few producers will be able to deliver unrated orders under this provision.

In general, Order M-41A makes it virtually impossible for producers of Class B end products to buy new machine tools. An exception is made for those firms whose authorized production schedules exceed the rate of production during the first quarter of 1951. The assumption in such a case is that the applicant must be working directly or indirectly on defense contracts, since all other Class B producers have been cut back. Another exception is allowed for producers who need ratings to replace worn-out tools.

Changes in the "rules" were announced by Swan Bergstrom, director of the NPA Metal-working Equipment Division. He said that the output of metal-working machinery must be doubled in 1952 if the needs of the armament program are to be met. The orders, he noted, amount to a freeze of automobile models until further notice.

MAKERS of tools, dies, jigs, and fixtures have petitioned the National Production Authority for additional assistance in meeting commitments. This industry reports a backlog of orders ranging from four months to more than a year—the largest in the history of the industry. NPA has told the industry to be prepared to produce large jigs, fixtures, and dies—15 feet or more in length and 15 tons or over in weight. The industry spokesmen replied that if such a demand is to be met, the following assistance will be required: Government directives to assure delivery of machine tools now on order; prompt allocation of controlled materials, with supplementary allocations if needed; and Certificates of Necessity, in order to permit rapid amortization of expanded facilities. Industry spokesmen informed NPA that, since their orders involve tools of special design for immediate delivery, it is impossible to anticipate requirements one or two quarters ahead, which is one of the requirements of the Controlled Materials Plan.

AT press time, Washington was awaiting the issuance of a series of OPS regulations to place in effect the Capehart Amendment formula for refiguring prices to include post-Korean increases. There were indications that industry might find itself "out of the frying pan and into the fire" in trying to take advantage of the new pricing regulations. OPS officials have stated publicly that the Capehart Amendment formula is completely unworkable, and there is not much reason to believe that the implementing regulations will belie that indictment.

Suffice it to say that no machinery producer should attempt to put the new regulations into effect without advice of competent counsel or consultation with OPS advisers. While Office or Price Stabilization folks are not too happy about the Capehart regulations, they are still convinced that the control of inflation is one of two ways to defeat Communism. A reading of Communist manifestos—stating that the capitalistic world can be defeated either by arms or by financial collapse—leaves the impression that OPS warnings against runaway inflation must not go unheeded.

MILITARY Production News Bulletin No. 21, issued by the Office of the Secretary of Defense, contains the following: Forging and extrusion presses larger than any heretofore operated in this country will be demanded by the Air Force. They are to make large light metal parts for aircraft instead of assembling such large parts from smaller pieces. The estimated cost of the program is $210,000,000, to be spent over the next four years. Presses up to 18,000 tons capacity are now in use. Discussions have included the advantages and limitations of presses up to 75,000 tons capacity.

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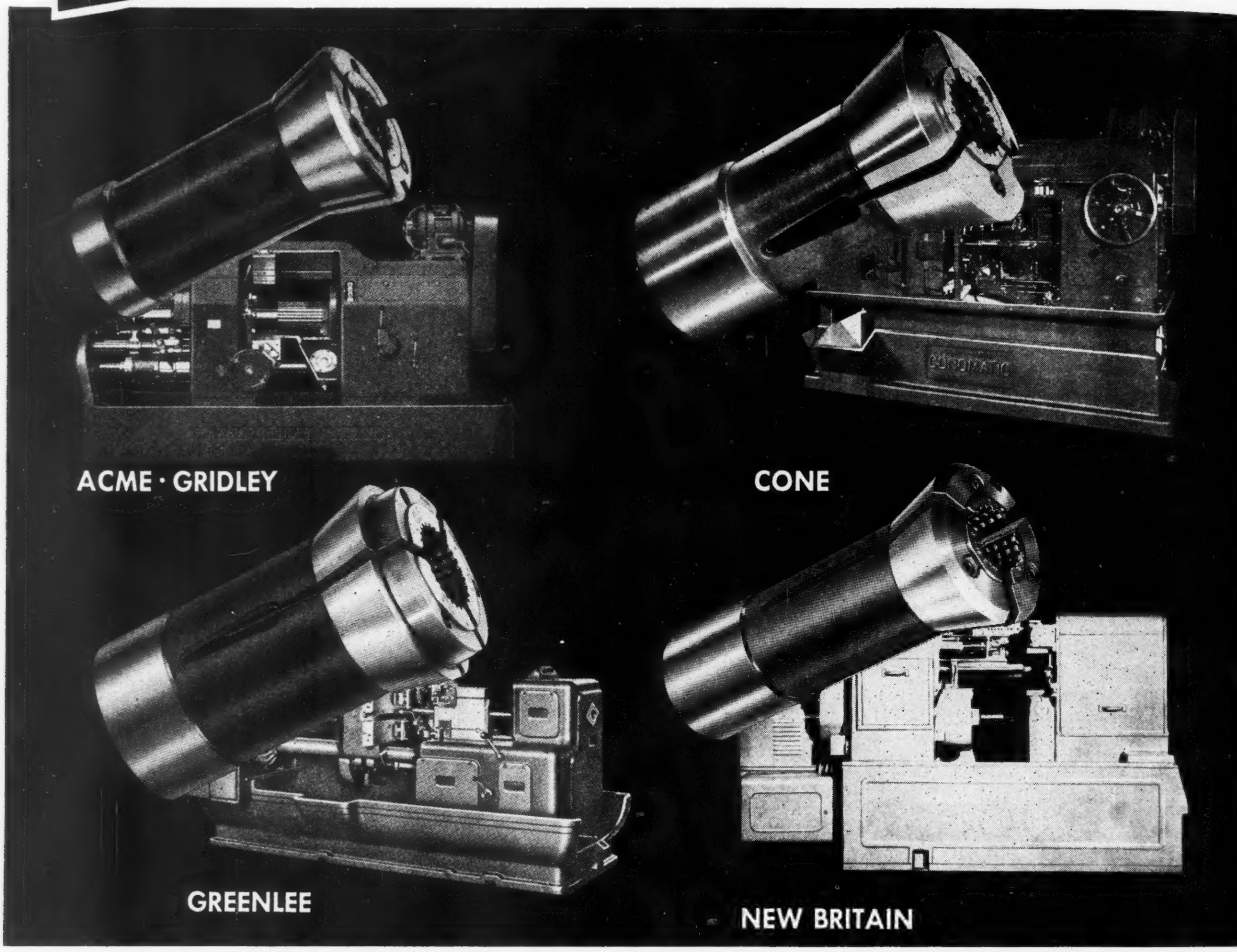

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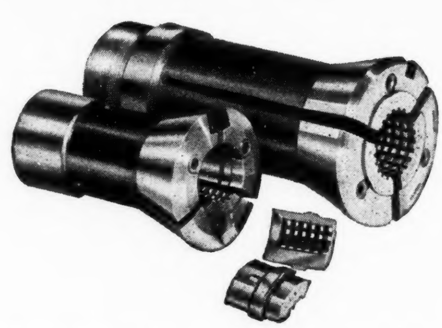

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HARDINGE BROTHERS, INC., ELMIRA, N. Y.

"PERFORMANCE HAS ESTABLISHED LEADERSHIP FOR HARDINGE"

1952 — Year of Destiny?

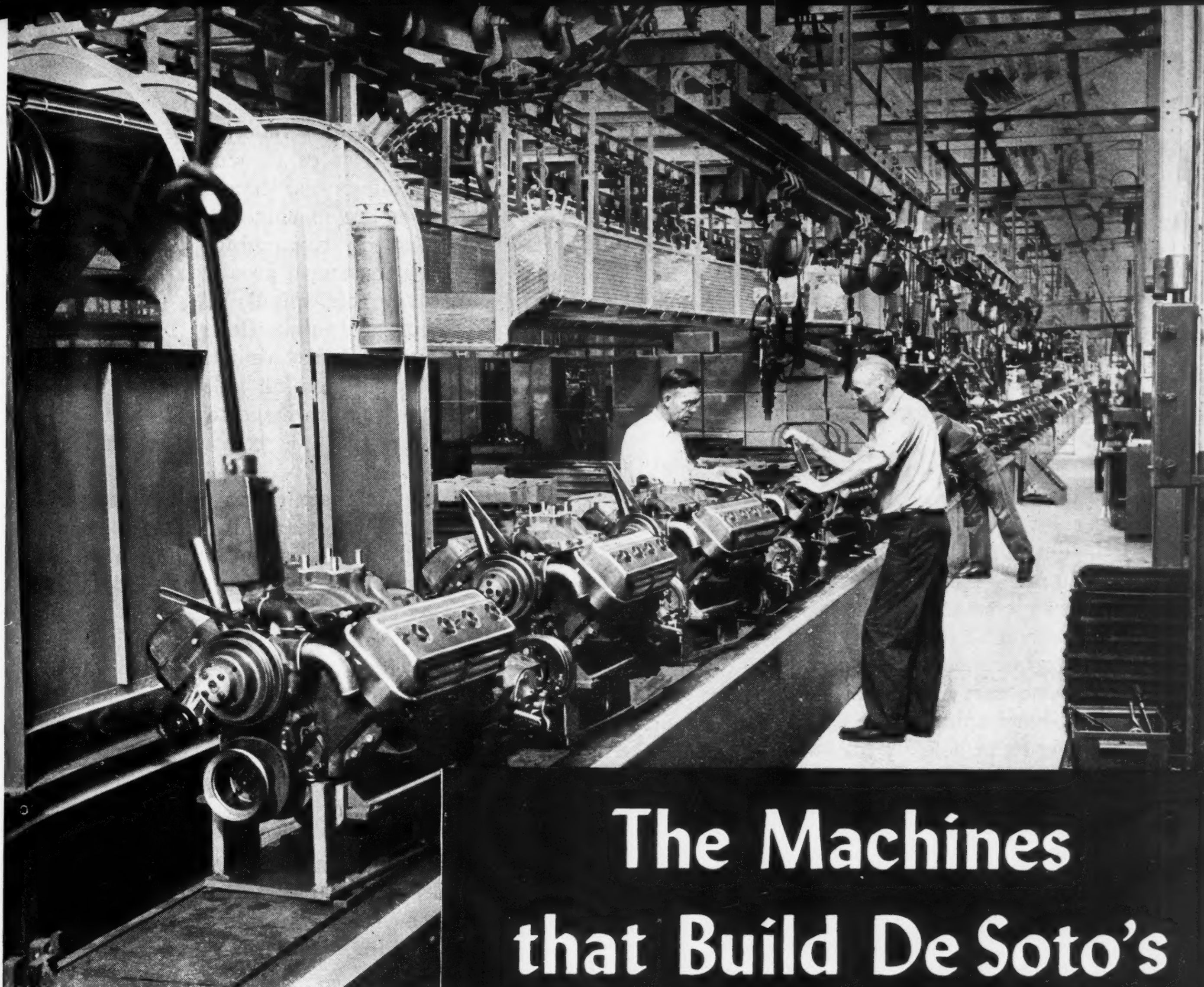
WE are standing on the threshold of a new year, which may well be a year of destiny for the nation and for the world. On the foreign scene, it seems that either the Korean conflict will be settled in some sort of compromise or world crises will continue to disturb peace-loving people.

On the domestic scene, we have a presidential election coming up, which may offer an abrupt change in foreign and domestic policies or a continuation of Fair Deal aims. We are looking at the disturbing picture of an early strike in the steel industry, which could start another round of wage and price increases and give impetus to more inflation—the thing that most economists consider the greatest danger to our national life. Will men ever again think of the public welfare instead of the gratification of selfish desires?

Whatever fate decrees for the coming year, the machine tool and metal-working industries start off on a boom level. Machine tools are the No. 1 item in our national defense program. The aim set for this industry is production at the rate of $1,500,000,000 annually by July 1. This will constitute a phenomenal achievement when it is remembered that production was at the low rate of $300,000,000 annually at the time war broke out in Korea, and that for nine or ten months after that event officials in Washington did not comprehend the importance of machine tools in preparing the nation for a possible full-scale war. Now the machine tool industry is being extended every possible help by government officials in its efforts to expand production, and the only serious problem remaining is lack of manpower skilled in the arts of the industry.

The metal-working field in general will be rushed in producing for the defense program, unless some miracle changes the minds of men so that the danger of another world war is averted. Then the industry would be just as busy turning out the products of peace.

Charles O. Herb
EDITOR



The Machines that Build De Soto's V-8 Engines

By CHARLES H. WICK

Unique Production Operations and the Latest Developments in Transfer Machines and Other Automatic Machinery are Employed to Produce DeSoto's Powerful New V-8 Engine

IN planning the production facilities for its powerful new V-8 engine, the DeSoto Division of the Chrysler Corporation has taken full advantage of the latest developments in machining practices. The engine, which has a 7.1 to 1 compression ratio and is capable of developing 160 H.P., will be introduced early this year.

More than 330,000 square feet of floor space is being used to produce this engine. Unique production operations and the latest type transfer machines and other automatic machines and tools are employed. Also, new materials-handling methods and automatic means for the disposal and recovery of waste metals have been developed. The result is a clean, efficient production set-up, which is capable of completing 60 engines per hour, or 960 per day operating on a two-shift basis.

One of the automatic transfer type machines employed to completely finish the cast-iron, V-type cylinder blocks for the new engines is the Ingersoll thirteen-station machine seen in Fig. 1. After loading the cast block at the first station, it is automatically indexed through an angle of 90 degrees, so that it can be transferred

through the remaining stations in a crosswise position.

Four milling cutters, two right-hand and two left-hand, are provided at the second and third stations to rough- and finish-mill both front and rear faces of the cylinder block. The cutters, 13 inches in diameter, each have forty-eight inserted, carbide-tipped blades, and are rotated at 250 surface feet per minute. A feed of 24 inches per minute is employed, and about 5/32 inch of stock is removed from each face of the casting.

Thirty-two holes ranging from 1/4 to 3/4 inch in diameter are drilled in the ends of each casting by means of a two-way, multiple-spindle drilling unit that straddles the fourth and fifth stations. Nineteen of the spindles are held in the two left-hand heads on the unit, and thirteen in the right-hand heads. The sixth and seventh stations are also equipped with a two-way unit, this one carrying nineteen left-hand and nine right-hand spindles for drilling and chamfering twenty-eight holes in the ends of the block. The various size drills are rotated at about 70 surface feet per minute and fed at the rate of 0.007 inch per revolution.

The center and rear intermediate cam bearing seats in the cylinder blocks are rough-bored, ten holes in the casting ends are drilled, and two more holes in the ends are reamed by means of a two-way unit that straddles the eighth and ninth stations. Two of the end holes are produced by 1 1/8-inch diameter core drills.

Two grooves are machined in the front end of the casting by trepanning tools, and the corners of the trepanned grooves are chamfered with a one-way four-spindle unit at the tenth station. Chips are automatically blown out of all the machined holes by air jets at the eleventh station. Following this, all holes drilled in the ends of the casting are inspected at the twelfth station, and the block is removed at the thirteenth station.

In this transfer machine, as well as in others in the cylinder-block machining line, the work is automatically carried from station to station switches insure proper positioning and clamping in position by cam-actuated plungers. The multiple-spindle heads at the various stations are hydraulically fed toward the work. Microswitches insure proper positioning and clamping of the part at each station before the machining cycle begins. A net production of sixty cylinder blocks per hour is obtained from each machine, based on an efficiency of 80 per cent.

Three more of the transfer machines in the line perform 379 separate operations on the top, bottom, sides, and end surfaces of the cylinder blocks. On the Greenlee machine shown in Fig. 2, seventy-six drilling, countersinking, counterbor-

Fig. 1. Cylinder blocks for the V-type engine are milled, drilled, bored, reamed, and trepanned on a thirteen-station automatic transfer machine

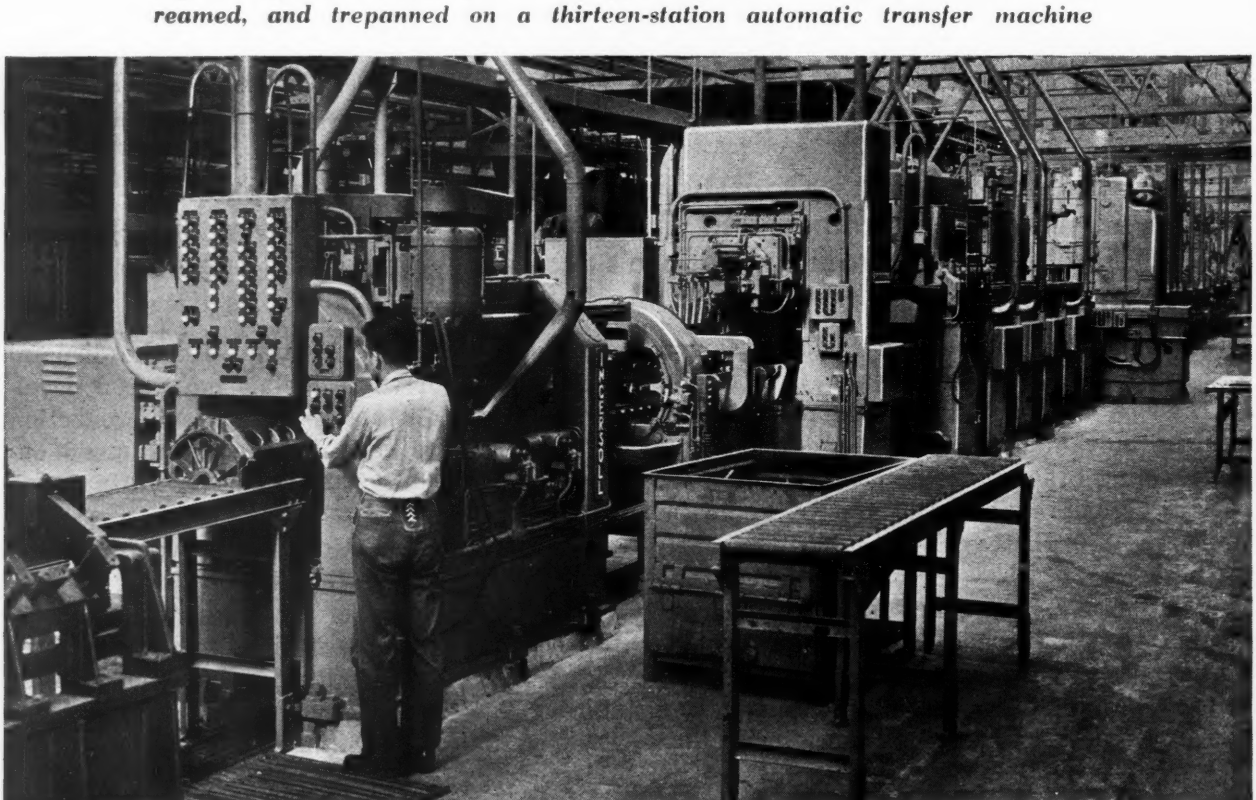
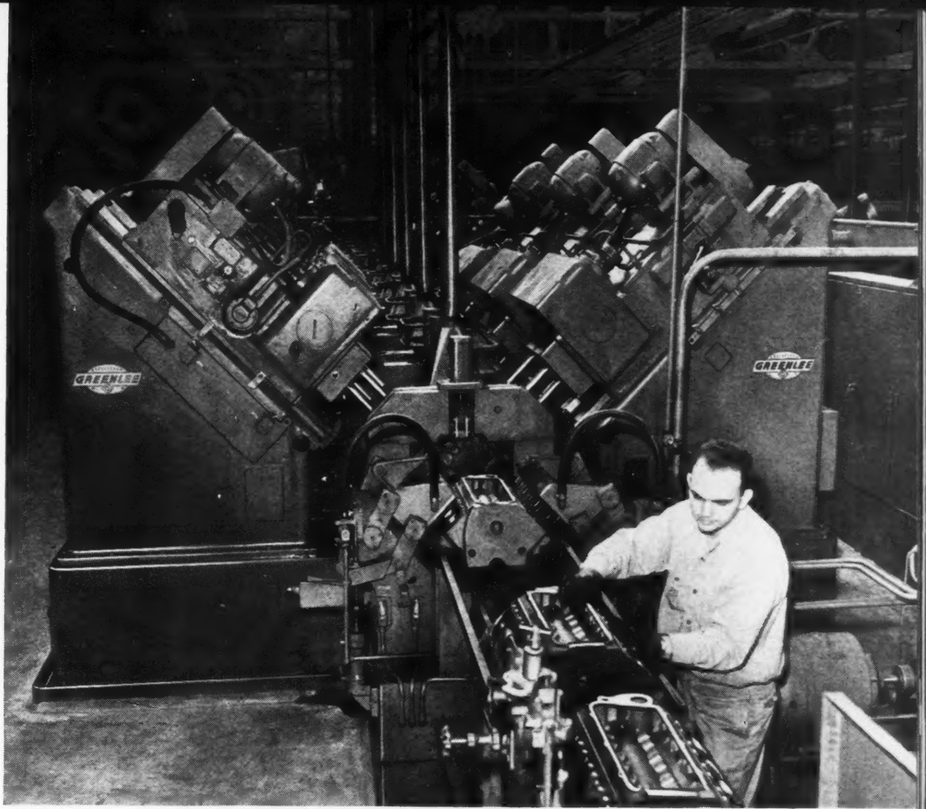


Fig. 2. Seventy-six drilling, countersinking, counterboring, and trepanning operations are completed in 43.8 seconds on the twenty-one-station transfer machine here illustrated



ing, and trepanning operations are performed in 43.8 seconds at twenty-one stations. The cast block enters the first station with its pan-rail side up and the front end leading. After drilling thirty-five holes and countersinking four more, ranging from 1/4 inch to 1 5/8 inches in diameter, the block is automatically rotated through an angle of 180 degrees, to position it with the pan-rail facing downward, by means of a fixture at the twelfth station.

Machining of miscellaneous holes in the casting is accomplished at the thirteenth to nineteenth stations, inclusive. These holes include those for the oil filter, main bearings, drain plugs, oil-pump, dip stick, and distributor shaft —the hole for the distributor shaft requiring a core drill 2 inches in diameter. At the twentieth station, air jets blow chips from the various holes and the holes are inspected. The casting is automatically ejected on a gravity roller conveyor at the twenty-first station.

A huge Cincinnati two-way, horizontal broaching machine (Fig. 3) is employed to rough- and finish-broach the top, bottom, intake face, and exhaust face of the cast-iron cylinder heads in one cycle. Two of these surfaces are broached when the ram moves to the right, and the other two when the ram returns to the left. The machine is equipped with a rack and pinion, planer type drive, which permits broaching with ram speeds up to 200 feet per minute. Approximately 3/16 inch of stock is removed from each

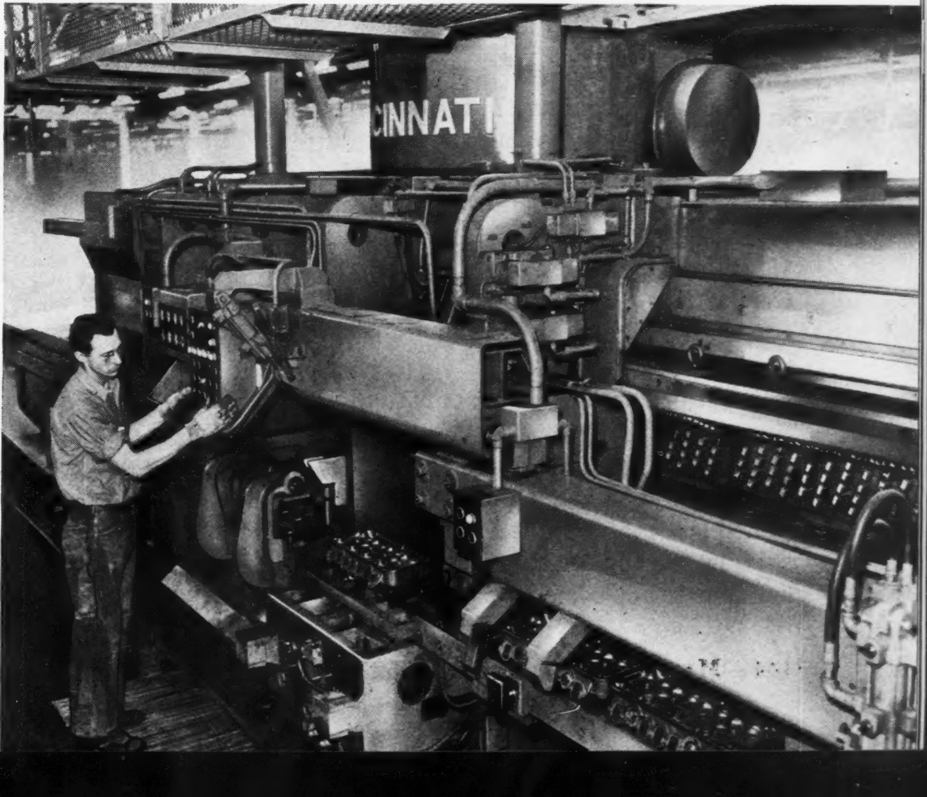


Fig. 3. Top, bottom, intake face, and exhaust face of the cylinder heads are both rough- and finish-machined on this two-way horizontal broaching machine

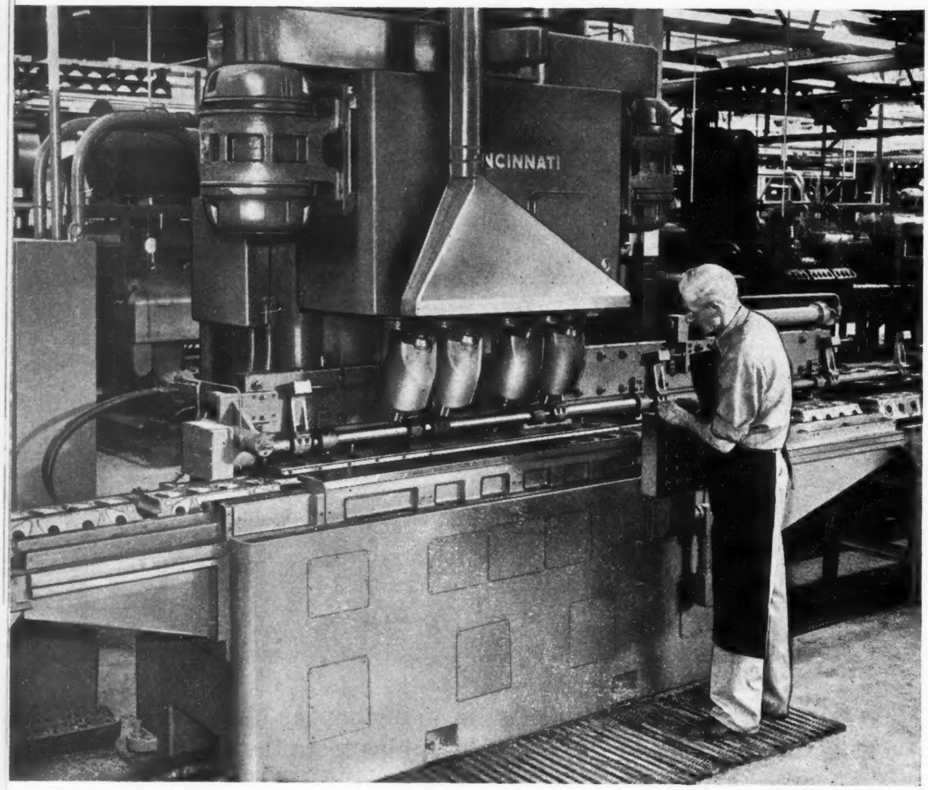


Fig. 4. Hemispherical combustion chambers in the cylinder heads are form-milled, four at a time, on a four-spindle, transfer type milling machine

of the four surfaces, maintaining flatness and parallelism within 0.003 inch. A production of 120 cylinder heads per hour is obtained from this machine.

There are four broaches, mounted in opposed pairs on the ram of the machine. Each broach is made up of three holders containing single-point, carbide-tipped bits for roughing, and one holder containing solid carbide blades for finishing. When the ram moves to the right, 190 of the bits rough-broach and 12 blades finish-broach the top surface of the head casting. Simultaneously, 212 bits rough-broach and 12 blades finish the intake face, including a 5/16-inch notch.

After the completion of this stroke, the hydraulic work-holding fixture is automatically transferred to the second station and the casting is rotated through an angle of 180 degrees. When the ram returns, 216 roughing bits and 12 finishing blades broach the exhaust face, and 168 bits and 12 blades broach the bottom face. Of the 3/16 inch of stock removed from each surface, approximately 0.020 inch is removed by the finishing blades.

A major contributing factor to the high horsepower rating of the new V-8 engine is the use of machined hemispherical combustion chambers in the cylinder heads. The chambers are form-milled, four at a time, on the Cincinnati four-spindle milling machine seen in Fig. 4. Cast cylinder heads come to the machine on a gravity roller conveyor, and are placed in the loading station. Here the heads are picked up, one at a time, by a hydraulically actuated transfer bar and carried through an automatic machining cycle.

At the first working station, two alternate combustion chambers in one head are form-milled. When indexed to the next station, the remaining two combustion chambers in this head are milled. Simultaneously, two chambers in another head are being milled at the previous station. It is necessary to mill alternate combustion chambers at successive stations because of the close spacing of the chambers.

The heads are located by means of two previously drilled holes, and are hydraulically clamped against the top rail of the machine. Each of the four cutter bodies holds two carbide-tipped tools. About 1/8 inch of stock is removed from each chamber.

Holes for both intake and exhaust valve stem guides are bored and reamed in the cylinder heads, after which the guides are automatically pressed into the heads and rough-bored and reamed. All these operations are performed on a Heald, twenty-three-station transfer machine. Locating positions for the intake and exhaust valve seats are rough- and finish-bored and generated, and the seat inserts are shrunk-fit into the heads, on the same machine. A production of 120 cylinder head assemblies per hour is obtained from this completely automatic machine.

At the first station, the cylinder-head castings are loaded into the work-holding fixtures. When the head has been automatically transferred to the second station, the four holes for the exhaust valve stem guides are rough-bored to a diameter of 0.674 inch ± 0.003 inch. At the same time, the four locating spots for the exhaust valve seat inserts are rough-bored to a diameter of 1.5025 ± 0.0005 inch, and these spots are chamfered. The four-spindle boring unit at this station is equipped with twelve cutting tools. The third station is idle, and at the fourth station, the guide holes are reamed and the insert seats finish-bored. About 0.010 to 0.013 inch of stock is removed from these eight surfaces, a tolerance of ± 0.0005 inch being maintained in these operations. Next, a hole 1/8 inch in diameter is drilled in each of the four exhaust valve stem guides, and the guides are inserted in the head by means of a hopper feed, drilling unit, and hydraulic pressing machine located at the sixth station. The cylinder heads are rotated to the desired position for subsequent operations with a turnover fixture provided at the seventh station.

Stem guide holes and seat-insert locating spots for the four intake valves are bored and reamed at the eighth and tenth stations, and the guides are hydraulically pressed into the head at the twelfth station. These guides are rough-bored and finish-reamed at the fourteenth and sixteenth stations, while the seat-insert locating spots are notched and finish-generated at the fourteenth station. The heads are repositioned by another turnover fixture at the seventeenth station.

Insert seats for the exhaust valves are fed by a magazine from a refrigerating unit which shrinks them, and are hydraulically pressed into the head at the eighteenth station. The seats are finish-generated and the exhaust valve stem guides are rough-bored at the twentieth station. Finally, the guides are finish-reamed at the twenty-second station.

After being broached, the cast-iron intake manifolds for the V-8 engine are drilled, milled, tapped, and reamed on the Snyder twenty-two-station special transfer machine illustrated in Fig. 5. The manifold is loaded into a fixture at the first station, and then automatically transferred to the different stations, where it is hydraulically clamped for machining. The left-hand, right-hand, vertical, and angular heads are equipped with a total of eighty-nine tools.

At the second station, eight-spindle right- and left-hand heads are employed to drill sixteen holes, 27/64 inch in diameter. Two angular heads (one right-hand and one left-hand) and a vertical head are provided at the twenty-first station to tap twelve holes varying from 5/16 to 7/16 inch in diameter. The tools are operated at a cutting speed of 100 surface feet per minute, with a feed of 0.0085 inch per revolution. The longest cutting cycle (twelve seconds) is needed

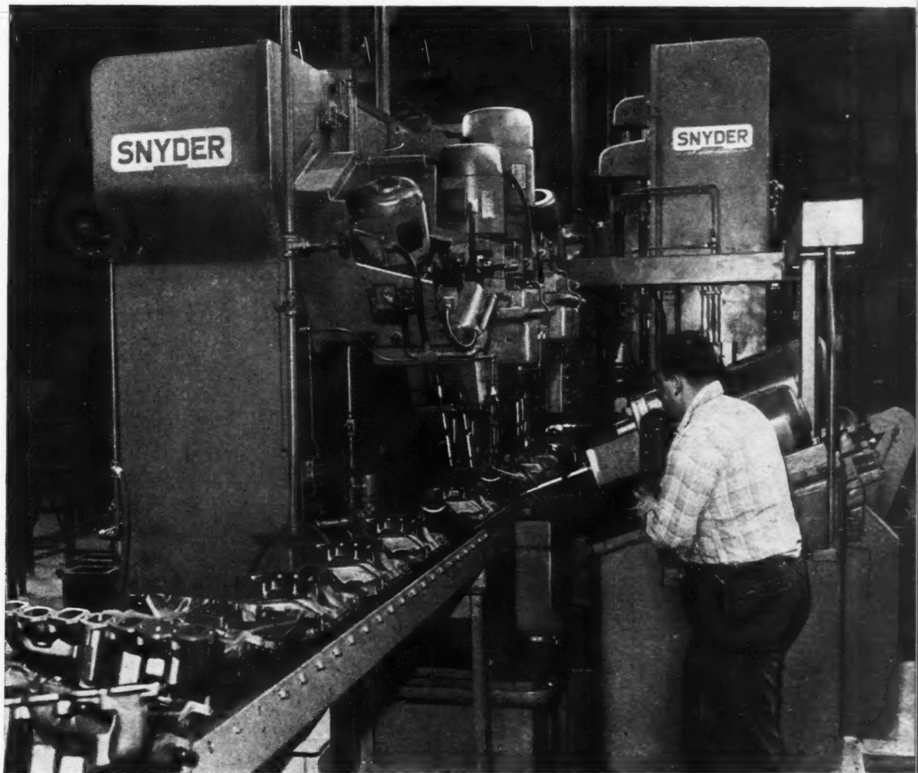


Fig. 5. Twenty-two-station transfer machine, equipped with eighty-nine tools, drills, mills, taps, and reams cast-iron intake manifolds

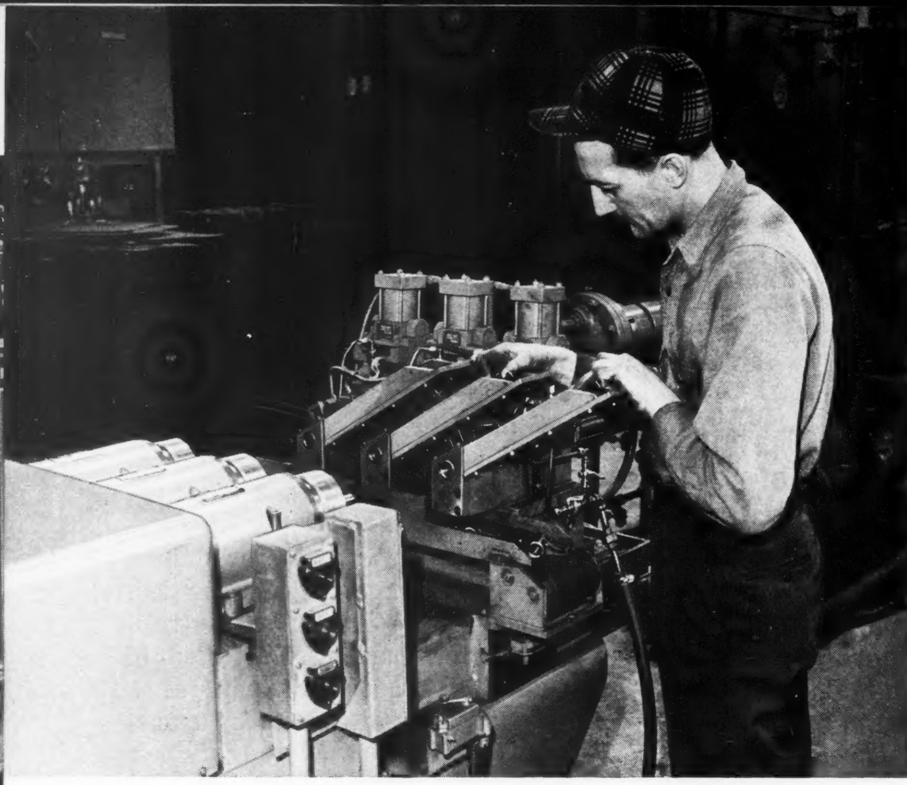


Fig. 6. An air and hydraulically actuated loading device on this machine speeds the boring of shaft holes in valve rocker arms

for drilling six holes, 27/64 inch in diameter by 1 7/16 inches long, with the drills rotating at 905 R.P.M.

Shaft holes in the valve rocker arms are finished, three at a time, on a New Britain precision boring machine, Fig. 6. The three-spindle machine is equipped with an air and hydraulically actuated loading and unloading device. Rocker arms are loaded manually into the tops of the three gravity chutes, and are automatically picked up, one at a time, from the bottom of each chute. Cam-actuated draw-bars automatically close the chucks, and the tools are fed through the rocker-arm bores.

The three boring-bars, each equipped with a single-point carbide-tipped tool, are rotated at about 500 surface feet per minute and fed at the rate of 0.003 inch per revolution. About 0.020 inch of stock is removed from each bore. While the boring-bars are being retracted, the chucks automatically open and the bored rocker arms fall on an endless belt conveyor that carries them to a tote pan at the front of the machine. The bores are machined to 0.8723 inch diameter within a tolerance of ± 0.005 inch in this automatic operation.

Both ends of the rocker arms are then hardened simultaneously in the Westinghouse induction heating machine seen in Fig. 7. The rocker arms are simply placed in the work-holding fixtures on the continuously moving endless belt conveyor, which carries them through the heat-

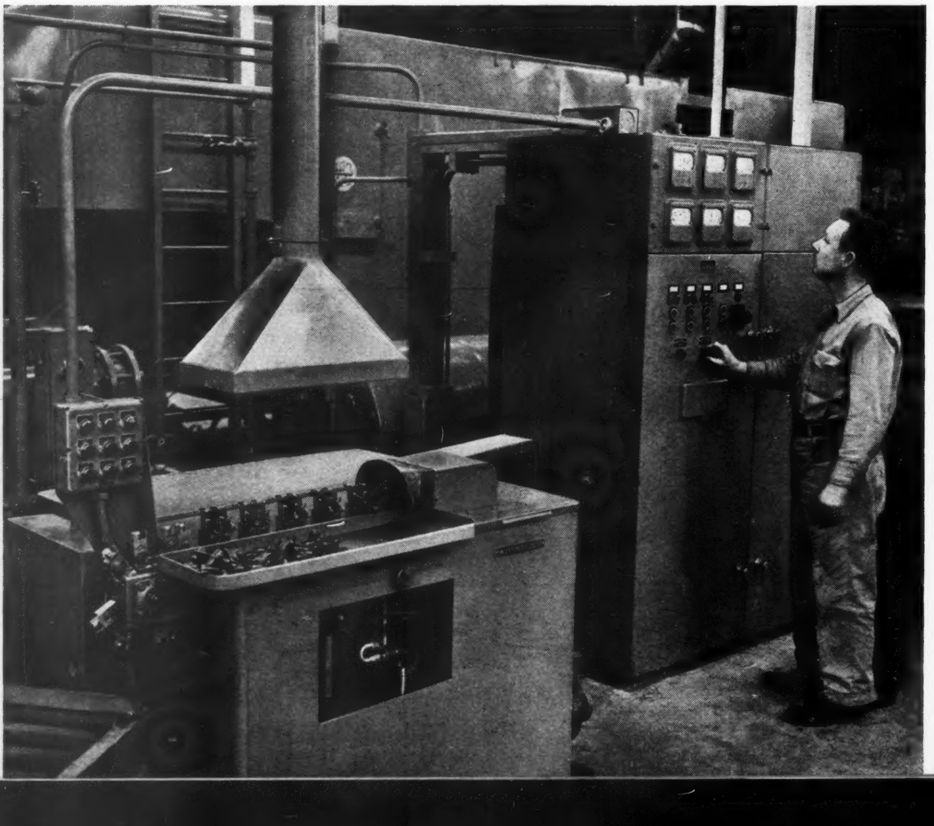
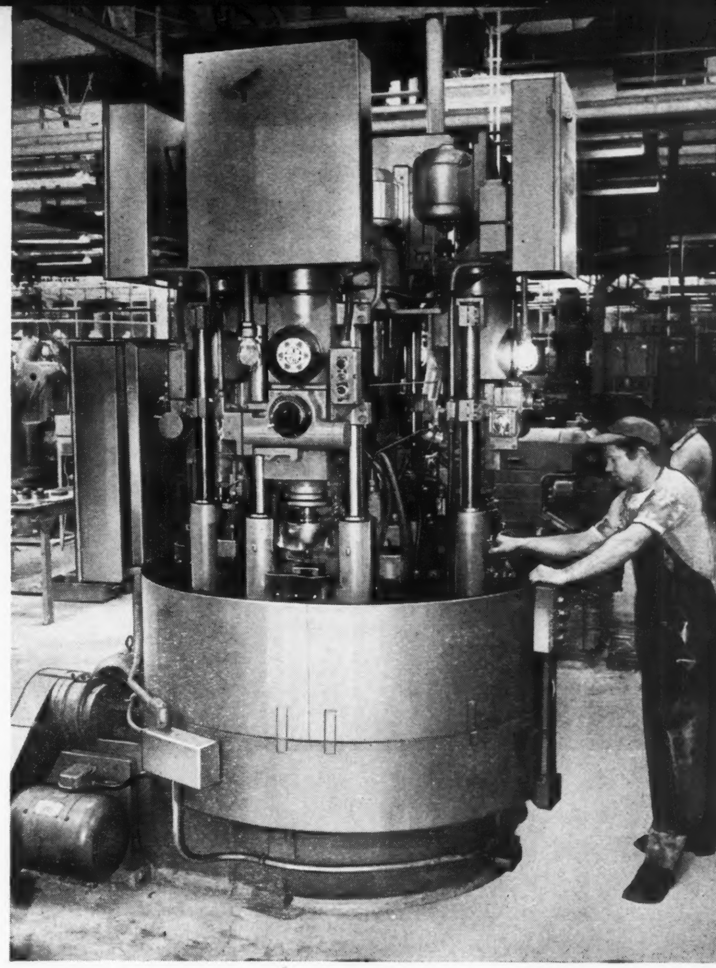


Fig. 7. Both the push-arm seat at one end of the rocker arm and the hydraulic valve lifter seat at the opposite end are hardened in this induction heating machine

Fig. 8. Shaft holes in the rocker arms are finished while the arms make one revolution around this four-station continuous honing machine



ing coils. Rails prevent the parts from falling out of the fixtures until they are over the oil quench tank.

A hardness of 50 Rockwell C, with a minimum case depth of 0.030 inch, is produced on both the push-arm seat at one end of the rocker arm and the hydraulic valve lifter seat at the opposite end. Intake valve rocker arms, as well as exhaust valve arms, can be hardened in the same machine by merely turning the fixtures over and adjusting the spacing of the heating coils to suit the length of the part. A production of 800 per hour is obtained when hardening both rocker arms.

Shaft holes in the rocker arms are finished on a Micromatic four-station continuous honing machine, such as shown in Fig. 8. Called the "Turret-Hone," this latest type of high-production machine has a rotary table that revolves continuously at 2 R.P.M. Four work-holding fixtures, spaced 90 degrees apart, are mounted on the table. Thus, the operator need only stand in one position and load and unload the fixtures as they pass him. When the fixtures leave the loading position, they are hydraulically lifted into the honing position.

As each honing tool enters the shaft hole in the rocker arm below it, the honing stones are automatically expanded at a pre-set, controlled rate. When the bore diameter reaches 0.8743 inch, a "Microsize" control automatically stops the expansion of the honing tool, provides a dwell period while honing is continued with the expanded tool, and then collapses the tool, stops the spindle, and lowers the fixture. When the fixture again passes the operator, the honed part is replaced and the cycle is repeated. From 0.0015 to 0.0030 inch of stock is honed from the shaft hole in this operation, and the bore size is maintained within a total tolerance of plus 0.0005 inch.

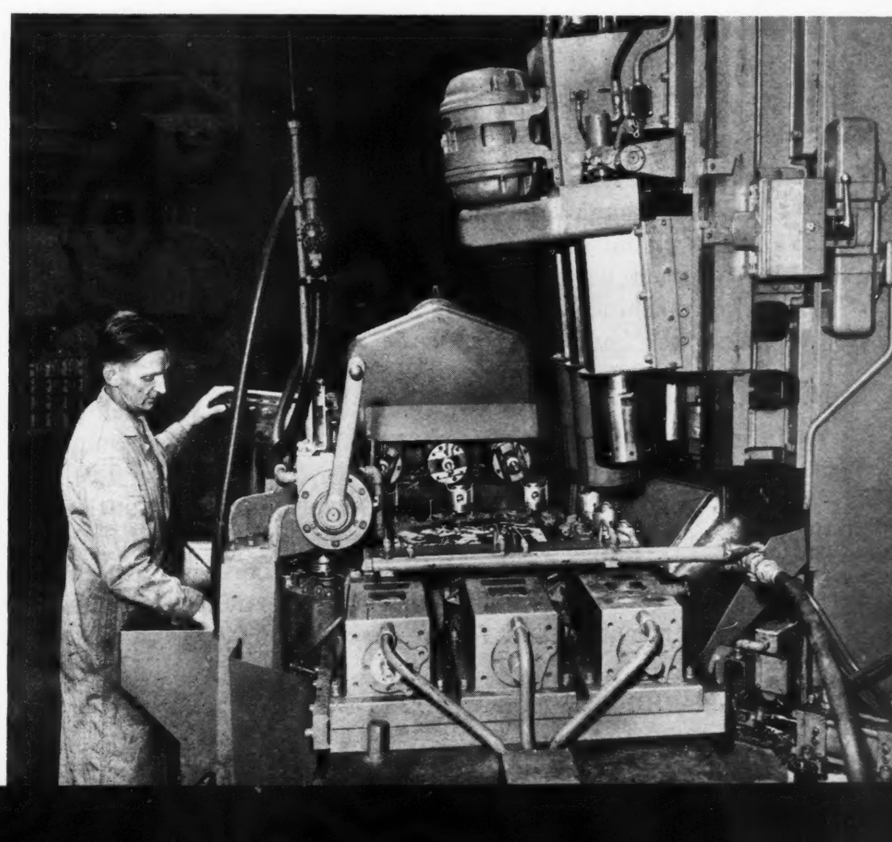


Fig. 9. Four-station indexing machine on which wrist-pin holes in the pistons are rough- and finish-bored and grooved, and the piston skirts are turned eccentrically

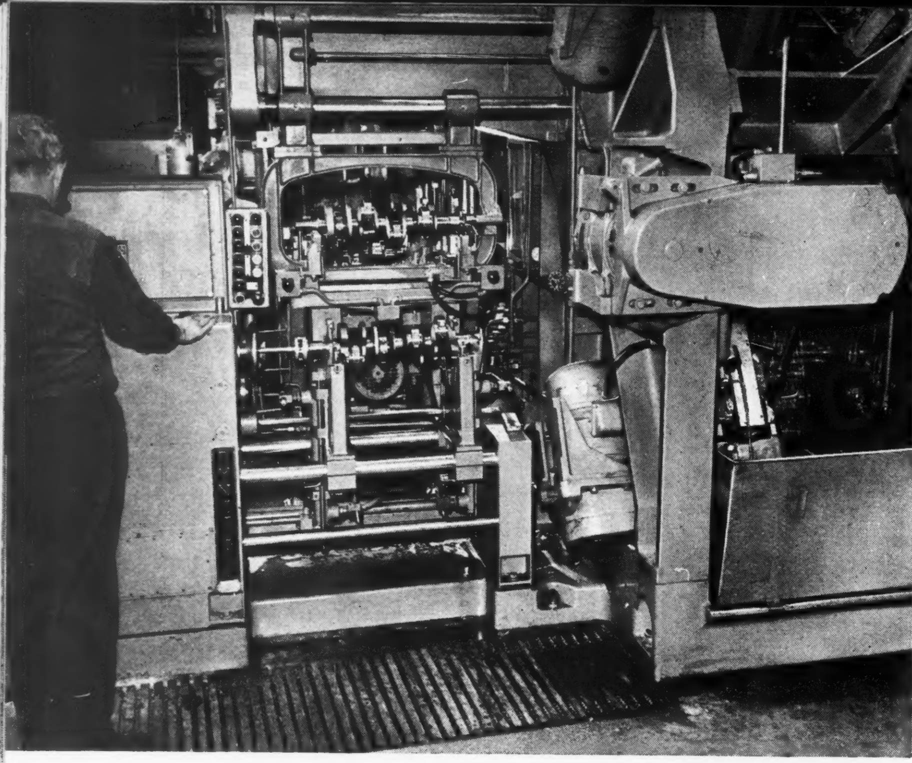


Fig. 10. Crankshafts are dynamically balanced in two operations on unbalance measuring machines provided with automatic correction drilling units

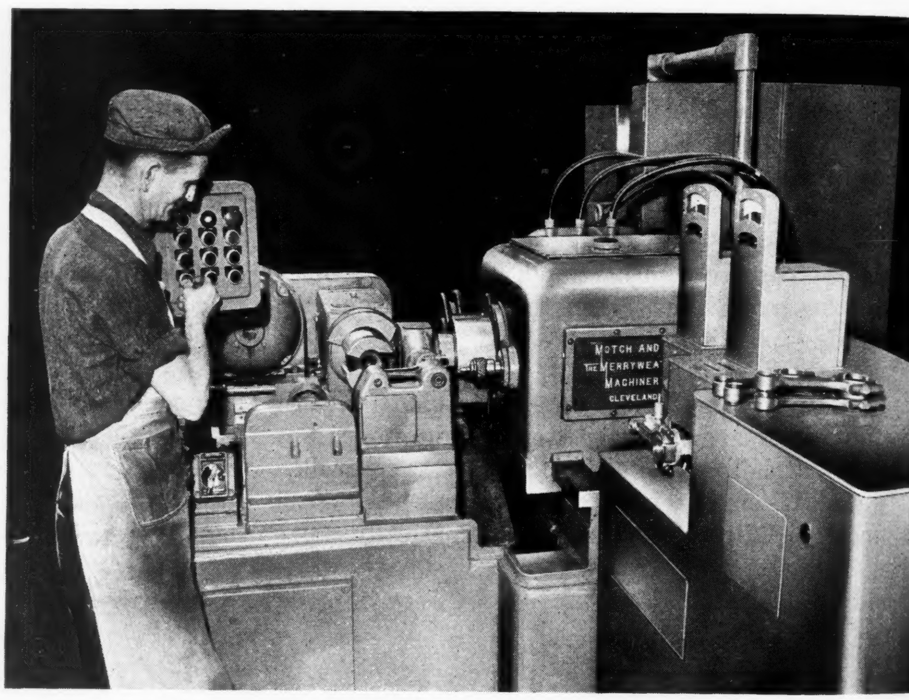


Fig. 11. Connecting-rod and cap assemblies are accurately balanced within a limit of 2 grams on an automatic milling machine that is equipped with a weighing unit

Wrist-pin holes in the pistons for the V-8 engine are rough- and finish-bored and grooved, and the piston skirts are turned to an elliptical cross-section on the Ex-Cell-O four-station indexing machine seen in Fig. 9. More than 400 pistons per hour are completed on this special high-production machine. The rotary indexing table is equipped with twelve work-holding fixtures, three at each station.

Loading and unloading are done by the operator at the first station, seen at the left. At the second station, the wrist-pin holes in three pistons are rough-bored and grooved. The boring-bars are rotated at 2000 R.P.M. (523 surface feet per minute), and fed at the rate of 0.003 inch per revolution during boring and 0.001 inch per revolution in grooving. When indexed to the third station, the piston skirts are turned to the required elliptical shape. The vertical, offset spindles at this station, which are equipped with single-point, carbide-tipped tools, are rotated, in this case also, at 2000 R.P.M. (1885 surface feet per minute), and fed at 0.003 inch per revolution.

The wrist-pin holes are finish-bored at the fourth station, with the tools rotating at 3600 R.P.M. (868 surface feet per minute) and fed at 0.002 inch per revolution. This is the longest machining cycle of any of the stations, requiring 35.5 seconds to complete the three pistons. The

pistons are removed from the fixtures after they have been indexed back to the first station.

Extremely accurate dynamic balancing of the crankshafts is accomplished in two operations performed on Gisholt Dynetric unbalance measuring machines provided with correction drilling units, as seen in Fig. 10. In preliminary or "rough" balancing, the dynamic unbalance of the crankshaft is quickly and accurately measured on the balancing machine seen at the left.

Electrically connected to this machine, and located at the right of it, is a six-spindle correction drilling unit, each spindle of which is equipped with a 7/8-inch diameter drill. The depths required to be drilled in order to correct the unbalance are automatically set while measuring the unbalance. Thus, when the crankshaft is transferred from the balancing machine to the drilling unit, six holes of the correct depth are automatically drilled without the need for the operator to note readings and set the drills. While one crankshaft is being drilled, another shaft can be measured for unbalance, thus expediting production.

The drilled crankshafts are automatically transferred from the drilling unit to a second unbalance measuring machine, located directly behind the first. This final balancing machine is arranged with a two-spindle correction drilling unit, each spindle holding a 7/16-inch diameter drill.

Connecting-rod and cap assemblies are accurately balanced within a limit of 2 grams by means of the Motch & Merryweather automatic milling machine shown in Fig. 11. Each end of the connecting-rod and cap assembly is individually weighed on a Toledo scale adjacent to the milling machine. Any overweight of the assembly causes the cutters on the milling machine to be automatically set to remove the amount required to bring the part into balance. After weighing, the assembly is placed in the hydraulically actuated clamping fixture on the machine. Two opposed milling heads on the machine automatically remove sufficient stock from each end to bring the assembly within balance. Three hollow mills with carbide-tipped cutter blades machine the pin end of the assembly to a diameter of 1.187 inches, with a maximum depth of 5/16 inch. Eight carbide-tipped blades cut the boss on the crank end.

The operator places an assembly on the scale while the previous one is being milled. In this way, 240 assemblies can be balanced per hour. A master connecting-rod assembly is provided to check the scale and machine settings.

High-Speed Counting Instruments

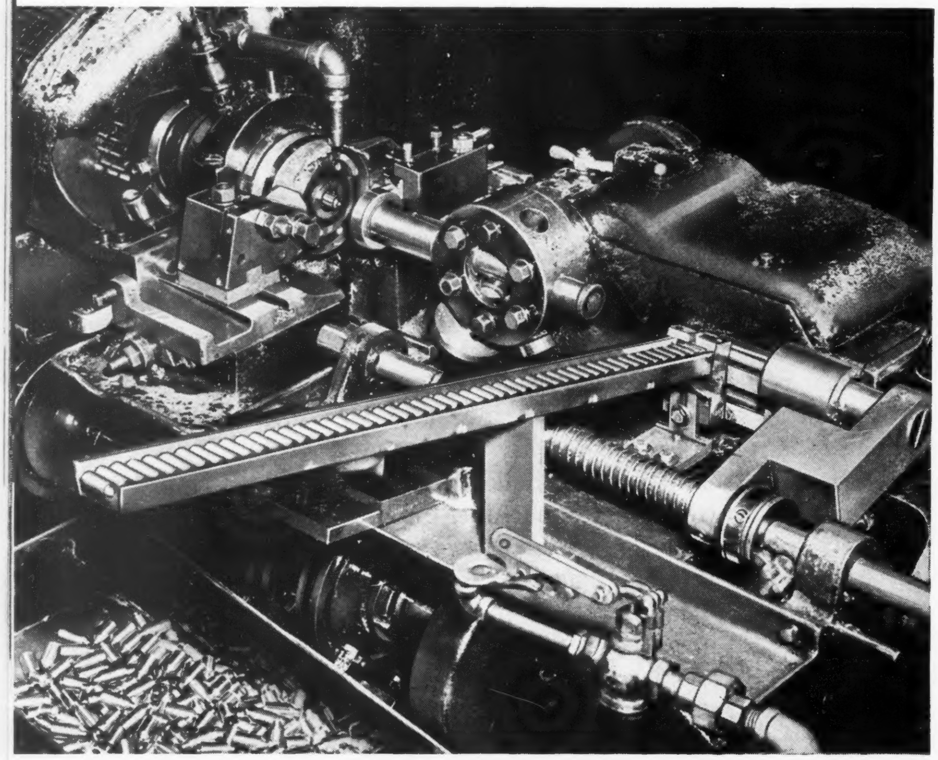
High-speed counting at nearly ultrasonic rates can be accomplished by design engineers, scientists, and producers through the use of two new models of "Detectron" electronic totalizers available from the Stratex Instrument Co., Los Angeles 27, Calif.

These novel counters, in conjunction with conventional equipment, are said to open new fields of investigation of physical phenomena involving functions of time, radiant energy, sound, light, acceleration and velocity, harmonics, and stress analysis. Typical applications are found in hydraulic and pneumatic fields, stress analysis, nuclear physics, aerodynamics, missile design, and in the determination of production and flow rates in the processing and fabricating industries.

These units weigh 10 ounces, and are 1 1/2 by 5 by 5 1/2 inches in size. The Model TU-9 automatically records impulses up to 30,000 per second, while the Model TU-100 will record at rates as high as 100,000 cycles per second. Both units are provided with base plugs for individual or series mounting in conjunction with other equipment or circuits. By the use of a series of units, direct readings of nearly astronomical proportions are instantly available on the brilliant internally illuminated panels, with instant external resetting. The power supply is 200 to 400 volts, negative. Tubes and circuits in the instrument are shielded in aluminum alloy.

High-speed counting and totalizing instrument of new design having a wide range of uses

Magazines and Hoppers Expedite



The Application of Magazine and Hopper Feeds to Screw Machines, Centerless Grinders, and Other Machines has Increased Production and Greatly Reduced Labor Costs in Both Machining and Inspection Operations. Typical Examples, Taken from the Buick Service Machine Shop in Flint, Mich., are Described in This Article

By HERBERT CHASE

MUCH has been done to reduce labor charges and expedite the handling of small parts during machining and inspection operations in the Service Machine Shop of the Buick Motor Division, General Motors Corporation, Flint, Mich. This plant produces hundreds of diversified small parts employed in Buick cars but as schedules are changing constantly, it operates more or less on a job shop basis. In many cases, however, quantities are sufficient to justify automatic or semi-automatic feeds, which quickly pay for themselves through economies in labor costs.

For example, the production devices described in this article have effected noteworthy savings in manufacturing the parts seen in Fig. 1. Two of these parts, after primary operations on automatic screw machines, are delivered to the two screw machines shown in the heading illustration and in Fig. 2 for secondary operations. Formerly, these parts were fed individually by hand, and an operator was needed at each machine. By applying automatic magazine feeds, however, one operator can now tend both machines, and labor charges for the secondary operations have been cut in half.

The part seen at the left in Fig. 1 is a poppet control valve for Dynaflow transmissions. Secondary operations on this part are performed in the set-up shown in Fig. 2. All that is required of the operator is to place the parts, with their finished ends toward the spindle, in the inclined magazine mounted on the front cross-slide of the screw machine. When a machined part has been ejected from the spindle collet, the magazine is advanced so that the lowest piece is in line with the collet opening.

A loading bar in the turret advances and pushes the work-piece into the collet against a stop, at the same time compressing a spring mounted in back of the work. The collet grips the part before the turret retracts. Then the cross-slide withdraws and tools in the rear slide and turret make their cuts in the usual way, after which the collet opens and the spring ejects the work-piece, completing the cycle. As the magazine is retracted, a new piece falls into the trough at the lower end of the magazine and is ready for loading into the collet during the next cycle.

In the second screw machine set-up, shown in the heading illustration, a pressure regulator valve having a conical end, as seen at the right in Fig. 1, is produced from the blank shown next to it. The blank has a cylindrical nib which is machined off in forming the cone. For this operation, the blanks are loaded from a fixed, inclined magazine, so arranged that the lowest work-piece is in line with the spindle, but in back of the turret. Mounted in the turret is a recessed load-

Production and Inspection

ing tool which, after loading one piece, indexes through an angle of 180 degrees to be aligned with the next piece in the magazine.

When the loading tool is correctly positioned, a spring-loaded pin on an arm attached to a sliding shaft below the magazine advances to push the lowest work-piece into the loading tool recess. While this loading proceeds, tools on the front and rear cross-slides produce the conical end on the piece already in the spindle collet.

During the next indexing, the part in the collet is ejected and the turret brings the new work-piece into position for loading. When the turret is advanced, it loads this piece into the collet. Forward motion of the sliding shaft below the magazine is effected (against spring action) by a cam on a positively driven cross-shaft at the end of the machine. The spring returns the shaft to its starting position as soon as the work-piece is in the loading tool.

After the conical end of these regulator valves has been machined and the parts ejected, they have to be passed, with the square end first, through a centerless grinding machine. To avoid hand loading, the rotating hopper shown in Fig. 3 is employed. The work-pieces are automatically directed into the curved tube shown, which leads to the grinder.

As the hopper rotates in a clockwise direction, some of the work-pieces fall into radial slots in an inclined back plate. These parts are brought to the top and in line with the hole in the tube unless the lowermost piece in the slot has its conical end down. In that case, the conical end of the valve comes in contact with the beveled edge of a fixed center plate, which lifts the piece out of the radial slot and causes it to fall back into the lower part of the hopper. Parts that are advanced in the radial slots with their square ends downward rest against a square edge above the bevel on the center plate. Thus, when in line with the tube, they slide into it square end down, as desired.

However, since there is space in each radial slot for several pieces, and one with its conical end down may be above one having the conical end up, both may fall into the tube, with the one on top incorrectly positioned. To prevent this, a pivoted lever is provided. The upper end of the lever is weighted, and it rests in such a position that it catches the second piece if its conical end faces downward, thus preventing the piece from falling into the tube. In that case, the incorrectly positioned piece is deflected and drops to the bottom of the hopper. This lever works by gravity, and is so made that the hopper cannot jam.

By means of this hopper, the grinding machine is fed automatically, and the only attention needed is to keep parts in the hopper and check ground pieces occasionally to see that their size is within the required limits.

A similar hopper, Fig. 4, feeds parts having a conical end into another centerless grinding machine in similar fashion. This part, called a "servo piston shaft" must also be fed with its square end down, but is longer than the regulator valve just considered and has a circumferential slot near each end. Parts fall into radial slots in the rotating back plate, as in the previous example. In cases where the work-piece has its pointed end down, the bevel on the fixed center disc makes it fall out before it reaches the loading position.

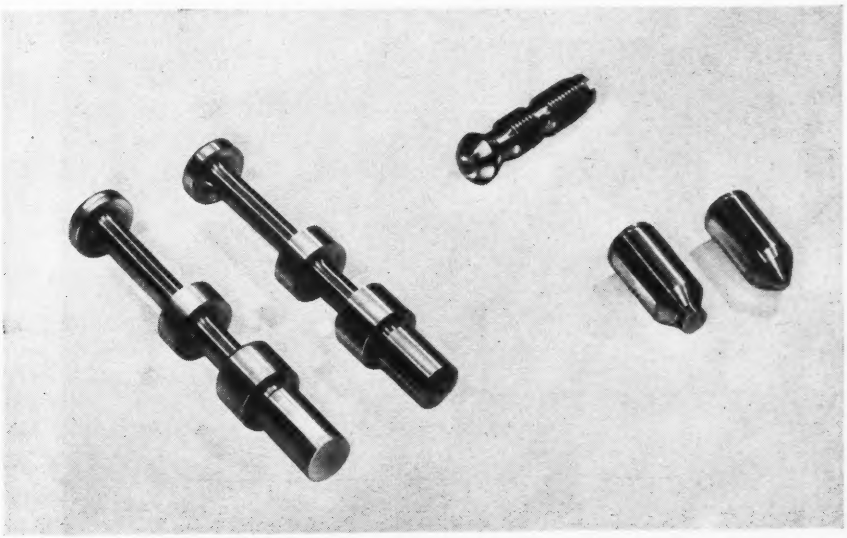


Fig. 1. Group of small automotive parts that are automatically fed and handled during machining and inspection operations by means of magazines and hoppers

Again, however, if a part has its square end down, and the one above it in the same slot is reversed, both could enter the tube unless some means of preventing this is provided. In this case, two rollers are employed for this purpose. The outer roller bears on the outer work-piece and keeps it from moving radially inward during a few degrees of dial rotation. The roller nearer the center of the hopper just clears the inner piece when it is in line with the tube, and allows it to drop into the tube. The inner roller, however, deflects any incorrectly positioned piece that is held momentarily by the outer roller, keeping that piece out of the tube. The same advantages gained by the grinder hopper previously described are also obtained in this case—the grinder operating automatically without manual loading except for scooping the work-pieces into the rotating hopper.

The way hopper feeds accelerate inspection operations will be evident from a few typical examples. Such feeds are used in the inspection of valve operating parts for Buick engines. Of these parts, two are employed as caps for tubes used as valve push-rods. One part, having a domed end, is applied at the lower end of the rod, and the other, having a ball socket, is used at the upper end. The third piece, seen at the top center in Fig. 1, is a ball stud, the ball fitting the tube socket and the threaded shank being screwed into a valve rocker. All three parts have small drilled holes that must be inspected to insure that they are free from burrs and chips.

Push-rod caps, called "uppers," are dumped into the rotating hopper seen in Fig. 5. The shanks of these parts are smaller than their cupped heads and fit radial slots in the rotating ring at the back of the hopper. Since the parts can enter the slots only with their heads up, they slide from these slots into a fixed channel in the desired position. The parts slide down the inclined channel, and pass over a ground glass plate on the inspection table. A light below the glass shines through the drilled hole in each piece.

The rate of flow is controlled by the finger of the girl doing the inspection. She looks through the drilled hole, and rejects any pieces in which burrs or chips appear. One girl can easily inspect 40,000 to 50,000 parts a day, or about two and one-half times as many as when each piece had to be positioned by hand.

A similar set-up, Fig. 6, is used for the lower push-rod caps, which have a hole drilled in the center of their domed end. The hopper feeds the parts crosswise through a channel, with their domed ends all on the same side. In this case, the channel has a 90-degree twist in it, so that the parts all reach the inspection point with their domed ends up.

Inspection is accomplished on a ground glass plate that forms the top of a box in which a lamp is placed. Parts that are accepted pass into a chute at the right and slide into a tote box. Rejected pieces, which have burrs or chips in the drilled hole, are diverted by hand and are returned to the drilling machine to have the holes cleared.

Ball stud inspection is more involved because each piece has two holes drilled at right angles to each other, in addition to threads that require visual inspection. Formerly, eight of these parts were laid in a row and picked up by an eight-tine fork, one on each tine. The tine entering the axial hole in the part, could be seen through the side hole, and the threads were also visually inspected while the parts were on the fork. This was a relatively slow procedure.

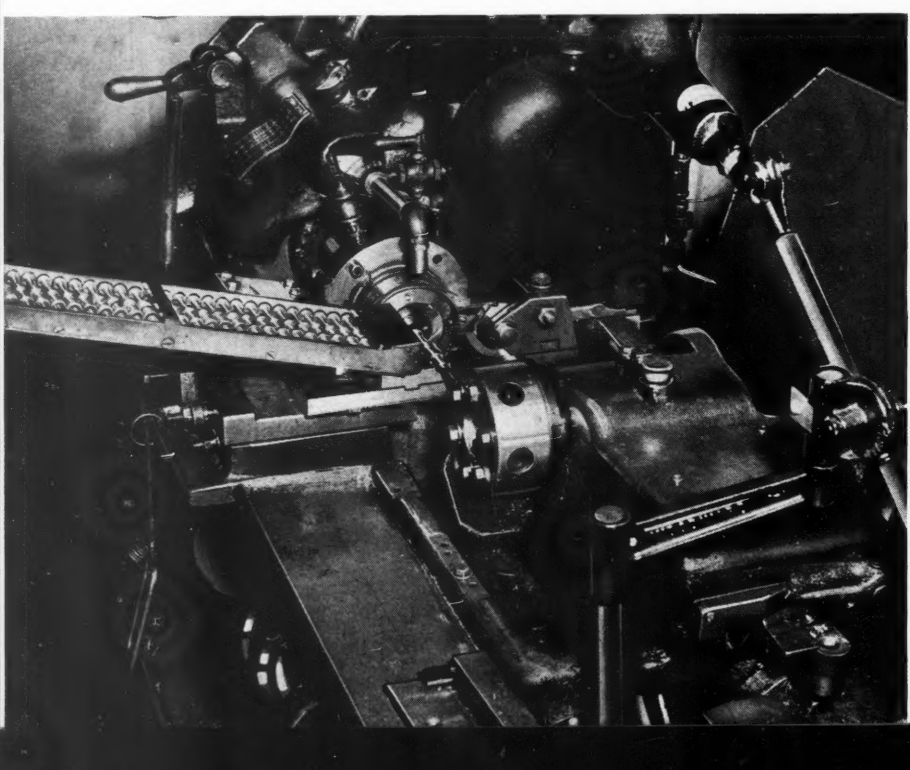


Fig. 2. A magazine mounted on the front cross-slide and a loading bar in the turret of a screw machine are employed to load poppet control valves, one at a time, into the collet

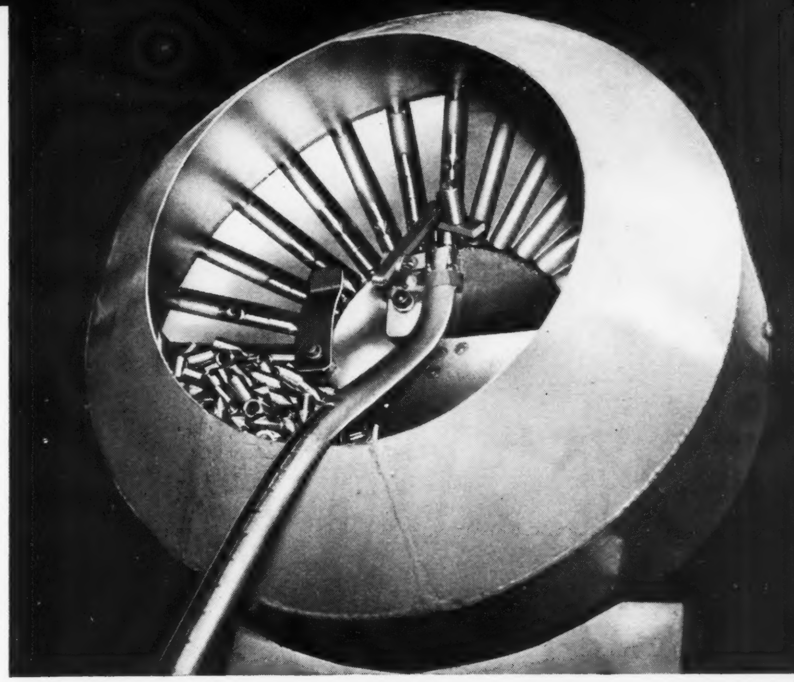


Fig. 3. Hopper employed for automatically feeding pressure regulator valves, square end first, into a centerless grinding machine. The lever above tube opening prevents parts from being fed wrong end first

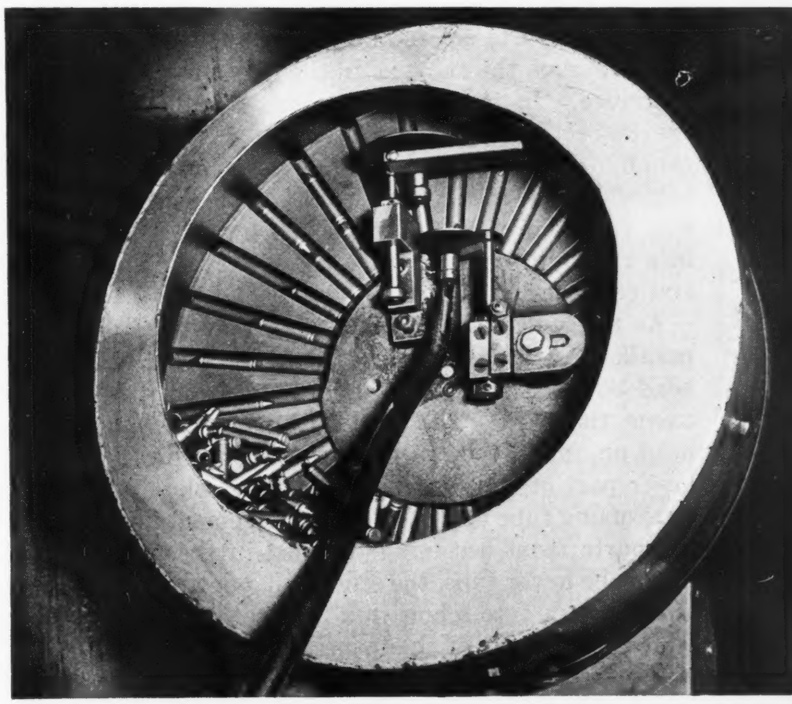


Fig. 4. In this automatic hopper feed for a centerless grinding machine, two rollers are employed to insure that workpieces enter the tube in the proper position, with the square-end first

Fig. 5. Ball-socket caps for tubular push-rods are fed in the correct position for inspection by means of this hopper. The caps pass over an illuminated ground glass plate on the inspection table

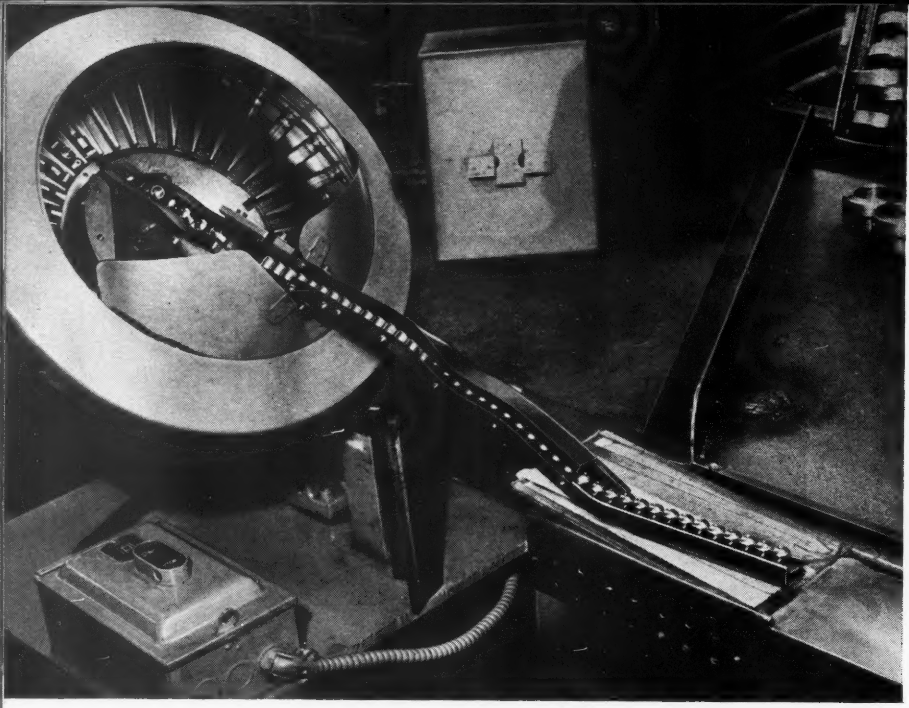


Fig. 6. Visual inspection of hole drilled in the domed end of push-rod caps is facilitated by the hopper illustrated, which feeds the caps—domed end up—across the inspection table

Now the parts are fed down a channel from a hopper, much the same as in the case previously described. In this operation, the threads only are inspected—one piece at a time, but quite rapidly. Accepted parts fall down a chute on a belt which elevates them into the hopper seen in Fig. 7. From there, they are fed into openings in a rotating dial shown at the right in Fig. 7 and edgewise in Fig. 8.

As the studs fall from the dial, they drop on parallel bars, spaced so that they catch the ball head but let the shank fall through the slot between the bars. The studs drop off the bars, head up, into a tube seen above the pulley in the lower part of Fig. 8, from which they slide into a revolving tube below. This arrangement keeps the parts from becoming jammed in the tubes. From the lower tube, the studs fall, one at a time and head up, into a hole in a reciprocating block which forms part of the inspection machine that is illustrated in Fig. 9.

In the block, each stud is carried horizontally under a plunger to which an air line is connected. The plunger is lowered onto top of the stud, and, if both connecting holes in the stud (one axial and vertical, and the other horizontal) are free, air passes through these holes, indicating that there is no obstruction. In this case, the piece is accepted, and a gate opens automatically, permitting the stud to drop into a bin for accepted parts.

If the holes have not been drilled through, or are obstructed, the air pressure built up operates a rejection gate. When the piece falls from the reciprocating block, it strikes this gate and is deflected into the box for rejected parts. After the inspected stud drops from the block, the block is moved back until the hole is filled by the next piece from the tube, and the cycle is repeated.

This machine is automatic, being operated pneumatically, mechanically, and electrically.

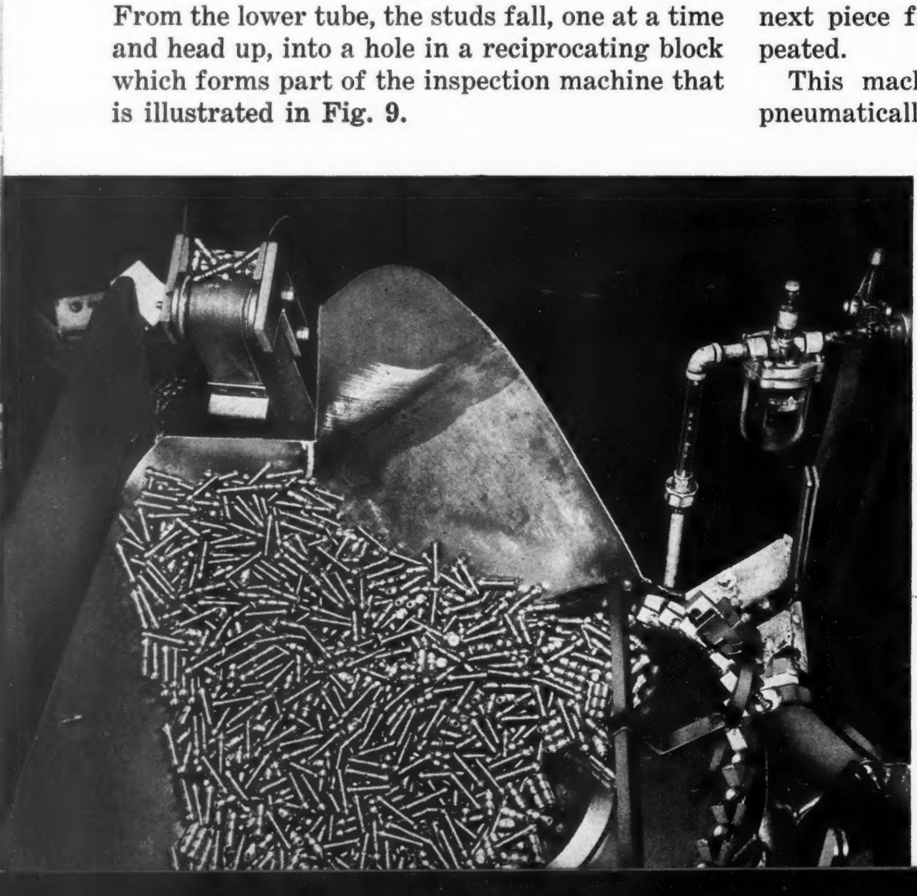


Fig. 7. Ball studs, falling into the hopper from the cleated belt seen at the upper left, are fed into a tube from openings in the rim of the inclined rotary dial. seen at right

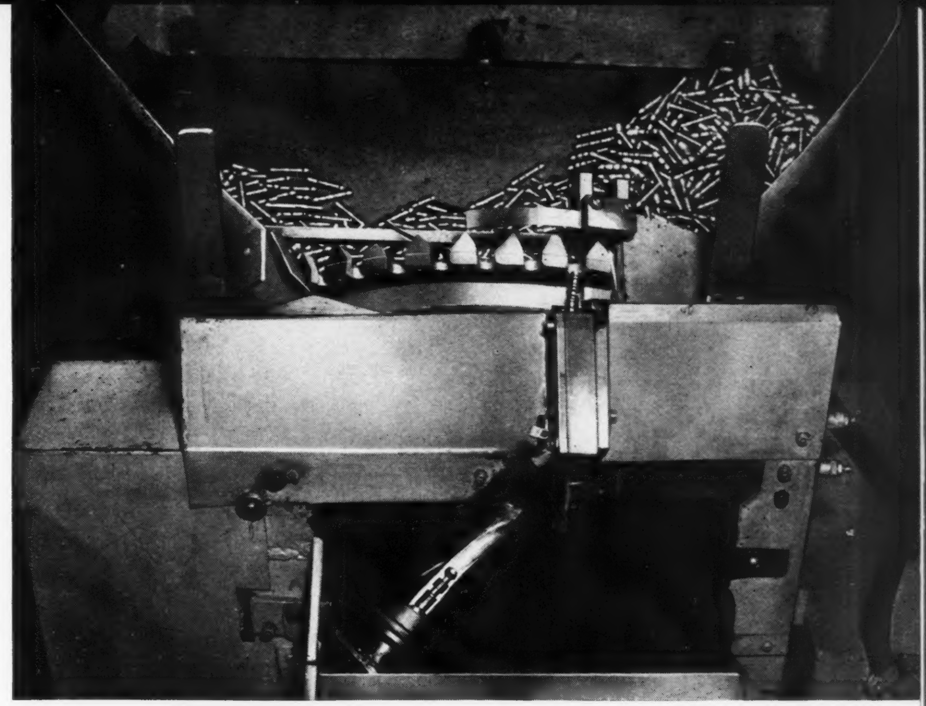


Fig. 8. Side view of the hopper seen in Fig. 7. Ball studs fall on parallel bars that catch their heads, and are fed into the tube below that leads to the inspection machine

Some parts, including the air compressor and the air-controlled plunger, may be seen in Fig. 9. Covers have been removed to reveal some of the machine elements. The reciprocating block which holds the stud during inspection is cam-operated, and its action is synchronized with that of the ram through which air pressure is applied. Operation of the gates for deflecting accepted or rejected parts into the proper bins is controlled by solenoids. One control is so arranged that if a piece is not fed down the tube from the hopper, the air will be shut off by a solenoid and the plunger will not operate.

With this machine, drilled holes in the studs are checked at the rate of eighty-four a minute, and it requires four girls for visual inspection of the threads to keep pace with the machine. The complete inspection, however, is about two and one-half times faster than formerly, and total inspection labor is reduced by about one and one-half girls.

From the foregoing, it is clear that magazine or hopper feeds effect marked labor savings, not only on certain production machines but on some inspection operations. In the case of stud inspection, the investment in a complete automatic machine, including hopper feed, has been fully justified by the faster rate and the labor savings attained.

* * *

Factory sales of motor vehicles in the first quarter of 1951 totaled 1,980,176 units, representing a slight increase over the sales for the first quarter of 1950, which was 1,853,532. These figures include cars, trucks, and buses built for the United States military services.

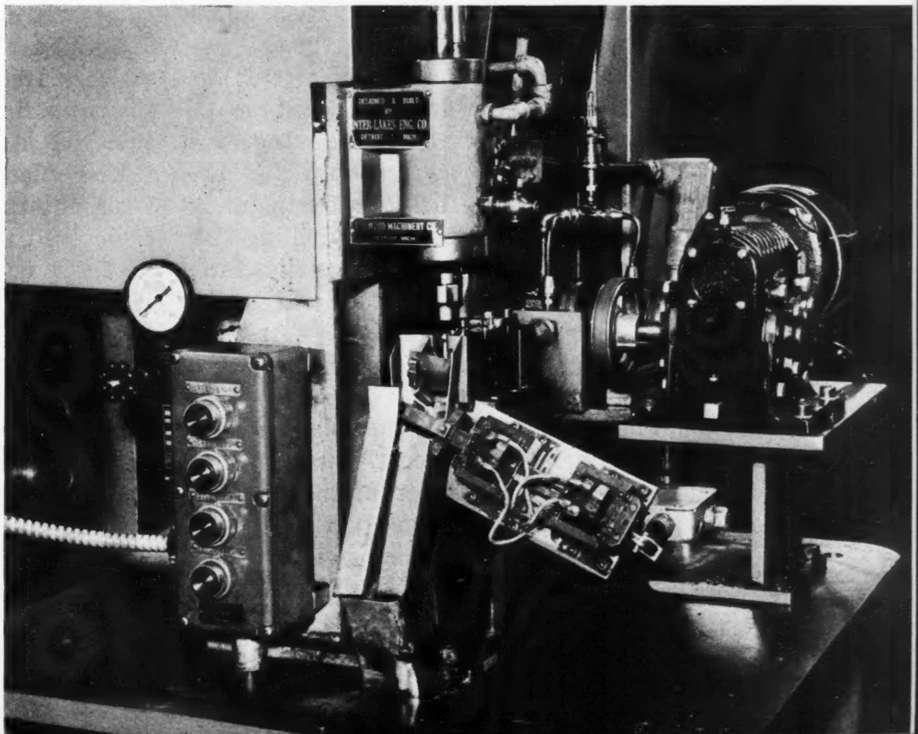


Fig. 9. In this machine, ball studs are subjected—one at a time—to air pressure. If the air passes freely through the holes in the work the part is accepted and automatically segregated

Technique Used in Producing

By
P. LE ROY VENABLE
Supervisor
Plaster Shop and Foundry
Northrop Aircraft, Inc.

Fig. 1. Pouring a plastic jig master for the main landing gear door on the F-89 "Scorpion" jet fighter airplane

SOME of the most critical production tools used in the fabrication of high-speed military airplanes, such as the F-89 "Scorpion" jet-propelled fighter, built by Northrop Aircraft, Inc., are of all plastic construction. These tools have many advantages. They can be made to conform to patterns within a tolerance of 0.0025 inch, and dimensions between widely spaced reference points can be maintained within 0.005 inch. Both time and money are saved by the use of plastic tools. Moreover, highly skilled workmen are not required for producing them.

It takes an average of about 50 per cent less time to produce a plastic tool than it does to make a metal tool at Northrop, and cost savings are calculated to run from 60 per cent up. At the present time, plastics are being used in many types of checking, trimming, and drilling fixtures, power brake and stretch press dies, and in other applications where the tool will not be subjected to severe impact loading. A plastic die used in stretch-forming fuselage sections is shown in Fig. 2.

It should be noted, however, that plastics have certain limitations. Their successful use depends to a large degree on the design of the tool and the workmanship used in its construction, as well as on the conditions under which it is expected to work. While the details of tool production differ to some extent, the basic procedure is the same.

Two materials are used by Northrop at the present time—Type 8000 tool plastic, which is available from Rezolin, Inc., Los Angeles, Calif., and PR-500 "Kast-on," a product of Poly Resins, Sun Valley, Calif. Both of these are phenolic materials, purchased in 625-pound units. Each unit comprises 500 pounds of resin plus 125 pounds of filler and catalyst. The filler and catalyst are mixed with the resin in the ratio of 1 to 4 by weight just prior to use. Some tool plastics are furnished in three-unit forms, with the resin, filler, and catalyst separate. These are then mixed together when ready for use.

Tool plastics are of the thermosetting type, requiring the use of moderate heat to transform them into the solid form. A great advantage of their use is the small dimensional change that occurs during the transition from the liquid to the solid state. With a good tool plastic, this change is negligible, and not to be compared with the severe shrinkage occurring when metals solidify. Inserts, reference points, and working surfaces established in the liquid state retain almost absolute dimensions during setting of the plastic.

Patterns used in the development of plastic tools may be constructed of any of the conven-

Plastic Tooling for Aircraft

tional materials; however, fiber-reinforced plaster has proved to be the cheapest and best. Wood patterns or wood inserts should be avoided when possible because wood shrinks excessively at thermosetting temperatures, thus destroying contours and accurate dimensions.

The construction of plaster patterns follows the usual techniques, using templates, splashes, etc., as required. Reference tooling will, of course, determine the exact procedure. The wall thickness of plaster patterns should not be under 1 inch; and, in order to facilitate quick dry-out, it should not be over 1 1/2 inches. The walls should be supported where possible by a steel framework. At Northrop, they are made of either "Densite" or "Hydrocal." These materials require about forty-five minutes to set, and can be dried by mechanical means at relatively low temperatures (not above 130 degrees F.) when speed is required. It is important that the plaster pattern be thoroughly dried. Any moisture will cause a soft surface on the subsequently poured plastic, resulting in a poor tool.

After drying, the pattern is sprayed or painted with two coats of sanding sealer, and lightly sanded between coats. A final light sanding is given after the second coat of sealer has dried thoroughly. At this point, a good grade of surfacer may be applied and sanded to remove any surface irregularities that exist. Next, two or more coats of blue molding lacquer are applied to obtain a high gloss surface. When the molding lacquer has dried thoroughly, the entire mating surface of the pattern is polished with a paste type wax, using a soft cloth, like cheesecloth. This waxing facilitates removal of the plastic casting.

When a metal master or sample part is used as a pattern, it must be degreased and then sprayed with two coats of Tygon paint. Spraying must be accomplished carefully to obtain a smooth surface, as it cannot be sanded smooth after spraying. While metal masters may be used for producing any number of plastic tool castings, the metal must be thoroughly cleaned and repainted before each casting operation.

In some cases, where the pattern will be used to make a number of plastic castings or will be used as a reference master tool, it may be made from the same plastic as the tool to be produced. When that is done, a plaster pattern is made by the techniques already described, and the plastic master tool is then made from this pattern.

The patterns used must always be carefully prepared as regards dimensions and surface finishes, since flaws of any type will be reproduced in the cast plastic. When more than one tool is cast, the surface of the pattern should be cleaned and rewaxed each time.

Mixing the tool plastic preparatory to pouring is a simple procedure. With Type 8000 plastic, the 1 to 4 proportions are carefully weighed out and combined with a mechanical mixer. A close estimate of the amount required can be obtained by calculating the volume of the casting and then dividing by 22 to get the number of pounds of plastic required, as this type plastic runs about 22 cubic inches to the pound. This weight-

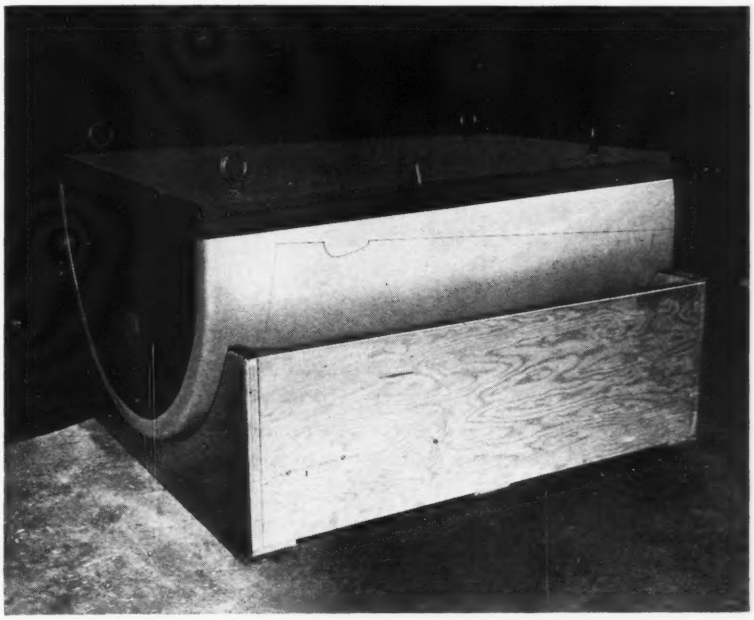


Fig. 2. A finished plastic stretch-press die with handling cradle. This tool is used in the stretch-forming of fuselage sections

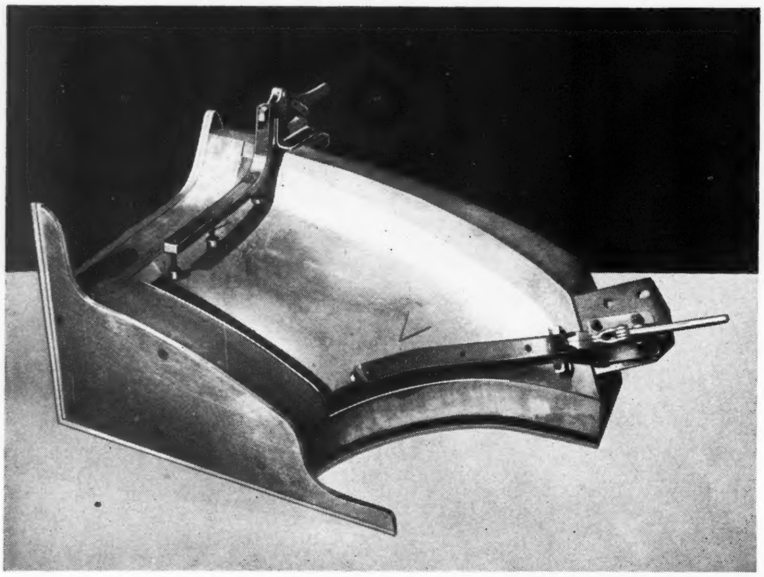


Fig. 3. Plastic saw fixture for a fairing skin. Trimming operations can be performed on three sides of a part by rotating the fixture to the proper position

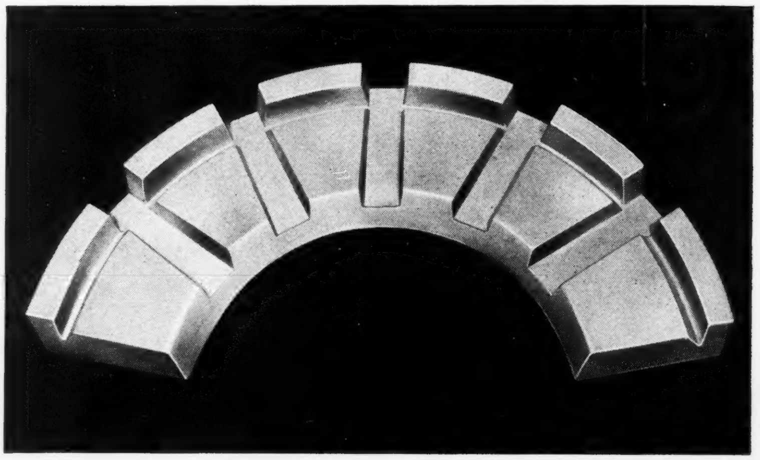


Fig. 4. Solid phenolic casting employed as a fuselage former in the production of the F-89 "Scorpion" fighter airplane

volume ratio remains almost constant owing to the small amount of shrinkage during setting.

Mixing should be accomplished at a relatively slow speed to keep air bubbles from forming. Any bubbles that do form will rise to the surface if the plastic is allowed to stand for a short time after mixing. Mixing should continue until all lumpiness has been eliminated, but should not be prolonged beyond that because a certain amount of thickening may occur, which will present some difficulty in pouring.

The mixed plastic is poured slowly into the mold to prevent the formation of air bubbles. To facilitate a smooth flow, the stream of plastic should be directed against the wall of the gate or mold. Pouring should be accomplished through one gate—preferably at the lowest point of the mold—with a riser placed at the opposite or highest point of the mold. All trapped air areas in the mold must be properly vented.

On long, thin sections, pouring must be accomplished from one end. A raised and gated end on the mold is preferred to obtain maximum head pressure at the opposite or riser end. With this arrangement, the raised end of the mold can be lowered while pouring continues. In pouring an open top mold, approximately 1/4 inch of excess material is allowed on top of the mold. When the mold is placed in the oven, it should be provided with a cover to prevent swelling of the plastic from uneven heat transmission. The pouring of a plastic jig master for the main landing gear door on the F-89 "Scorpion" is illustrated in Fig. 1.

Temperature inside the oven should be uniform at all points to secure even curing. In the Northrop shops, curing temperature is maintained at between 160 and 170 degrees F. The time required for curing depends upon the size and shape of the casting. In general, a casting weighing under 500 pounds can be cured in about twelve hours, while those over that weight will require from eighteen to twenty-four hours. There is no danger in over-curing, but under-curing will ruin the tool. The casting must be completely cured before it is removed from the oven. On the other hand, after the casting is thoroughly cured, it should not remain in the oven for prolonged periods, as the elevated temperature may have an adverse effect on the core

materials, especially if they are made of wood.

When the casting is removed from the oven, exposed areas are covered with a tarpaulin or blanket to prevent thermal shock from the sudden change in temperature. In extreme cases, sudden chilling may cause some warpage. The casting must not be removed from the mold until it is cold. Surface porosity is avoided by permitting the casting to set hard at room temperature before placing it in the oven.

If a plastic tool is chipped or broken, or if a change in design requires some alteration in the contour, the recommended procedure is as follows: (1) All tool surfaces affected are roughened with coarse sandpaper, and all foreign or loose material is removed. (2) A dam or mold is provided as required to encompass the repair or change of contour. Fiber plaster is a good material to use. (3) The amount of plastic required to make the repair or change is mixed. (4) The plastic is poured into the mold and cured at the recommended curing temperature.

In some cases, the repaired or altered sections may be cured by localized heat applications. Infra-red lamps are ideal for this purpose, but the heat must be controlled so that the surface temperature does not rise above the recommended maximum. After curing is accomplished, the new surface should be sanded and polished to the required shape and finish.

Most tool plastics can be easily machined, but care and the right techniques must be used. It is advisable always to work toward the center of the tool, in order to prevent chipping of the edge.

The types of tools used at Northrop in machining tool plastic and the technique employed in each case are as follows:

Lathe Tools—A negative rake of about 1 degree and a clearance angle of about 10 degrees are used on tool bits. The tool bit is set approximately 1 degree above the lathe center, as a tool located below center will have a tendency to chatter.

Drilling—Drills have a negative rake of 0 to 1 degree and a clearance angle of about 10 degrees. Drill speeds vary between 500 and 5000 R.P.M., depending upon the diameter and depth of the hole, the higher speeds being used for smaller diameters and deeper holes.

Milling—Carbide cutters are used, and are set in accordance with the manufacturer's recommendations for milling plastics.

Sawing—Band saws are used when possible with eight to ten teeth per inch, and blade speeds between 1000 and 1300 feet per minute. Circular

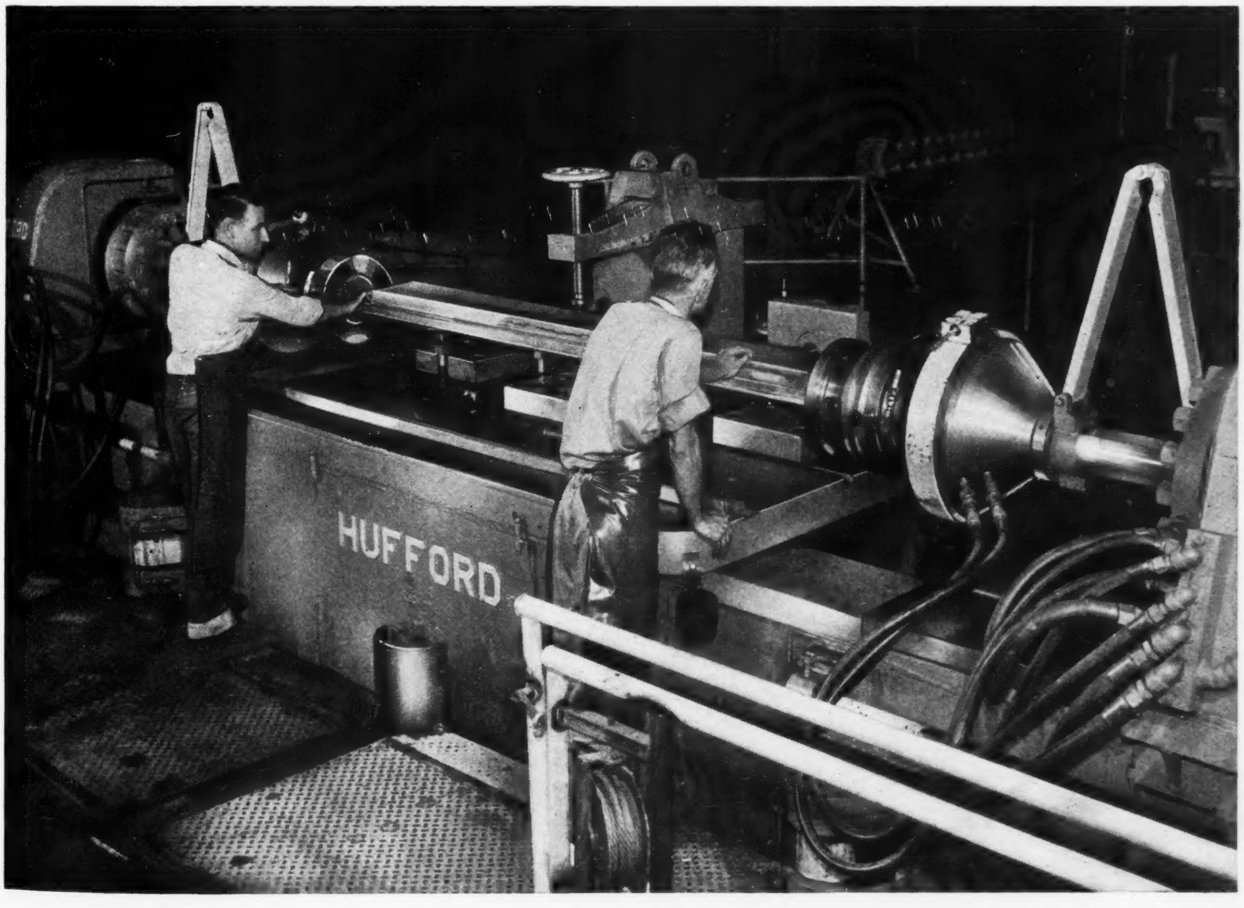


Fig. 5. Cast-phenolic stretch-form die used in a Hufford stretch press for producing aircraft parts

saws should run at the same surface speeds and have six teeth per inch. Fig. 3 illustrates a saw fixture for a fairing skin.

Warning—As plastic chips are corrosive, all tools and machines should be cleaned immediately after use.

Tool plastics have a limited life in storage, depending largely on the conditions. When stored at temperatures below 70 degrees F., the life is about three months. Higher storage temperatures reduce this maximum. Both the resin and catalyst containers must be kept tightly closed. This is important, as fumes from the catalyst are toxic and corrosive; also, foreign material, dirt, or metal chips of any kind must be prevented from getting into the resin or catalyst.

It is not within the scope of this article to go into the construction of specific plastic tools. The details will vary with each tool, and owing to the infinite number of tool sizes and shapes used in industry, core and mold construction is largely a matter of ingenuity. The only common requirements are adequate support for the casting and proper finished contours and shapes.

It has been proved that plastics can be employed for all tools except those that are subjected to impact loading. Such tools as stretch-press and drawing dies have been successfully employed for all normal shop applications. The use of a cast-phenolic stretch-form die in a Hufford press is illustrated in Fig. 5. Plastic shapes and templates have practically eliminated temperature and tolerance problems. A typical solid phenolic casting used as a fuselage former is shown in Fig. 4. This plastic tool is representative of many that have been used to advantage in the production of aircraft.

New Soldering and Brazing Unit Effects Labor and Material Savings

A new type of soldering and brazing unit designed to provide more efficient operation while, at the same time, effecting considerable savings in labor and materials is shown in the accompanying illustration. This unit — called the Mogul soldering or brazing gun—was developed by the Metallizing Co. of America, Chicago, Ill., and is suitable for special soldering jobs, as well as production runs.

The gun deposits lead and tin base solders, and also silver solder and other brazing wires, in a liquid or semi-liquid form on a part moving at constant speed under the gun nozzle. Soldering or brazing can be done either intermittently or continuously at any desired rate of speed up to a maximum of 200 lineal feet per minute.

The Mogul gun supplies soldering material in the desired quantity at the exact location required. The material, in wire form, is fed into the center of a conical flame, where it is melted into a liquid or semi-liquid state, depending upon requirements, and then deposited into the seam or area being soldered or brazed.

Considerable savings in labor and materials have been reported by users of the new equipment. In one case, a manufacturer of seamless copper ball floats effected a 70 per cent saving in solder, a 65 per cent saving in labor time for applying the solder, a 90 per cent saving in labor time for finishing seams, and additional savings in gas and grinding equipment. In this application, a lapped seam was completely sweated and a groove caused by the forming application was filled flush on the ball radius.

The new Mogul soldering gun deposits lead and tin base solders in a liquid or semi-liquid form on a part moving at a constant rate of speed under the nozzle

Line-Grinding Solves Many Shop Problems

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A RECENT addition to the modern band type of tools is the line-grinding band, which was developed to cut hardened steel (particularly for the salvage of damaged dies) and other extra hard or high-temperature alloys. This development permits the precision grinding of external and internal contours in a vertical position. The solution of this particular problem is especially timely, since it reduces operating costs and speeds material deliveries.

Line-grinding bands are made of a special alloy metal to which cubical molded abrasive matrices, or "teeth," of either aluminum oxide or silicon carbide are welded, as seen in Fig. 1. A balanced arrangement of the bond and grit provides a constant degree of abrasive exposure in the course of the cutting action. Both types of bands are available in grit sizes of 54 and 80.

The aluminum-oxide band is used in cutting heat-treated, heat-resistant steels and wear-resistant non-ferrous alloys. In cutting these materials, 80 grit is usually preferred because of its reasonably fast cutting action, combined with the hone-like finish produced. The silicon-carbide band is employed for cutting geological, silicified, vitrified, and other materials in this category. It is highly recommended for limited production in this connection because of its low initial cost compared to that of the diamond band. This article is concerned particularly with the possibilities of the aluminum-oxide band, as based on a few interesting case histories.

Even if the economies realized by line-grinding were limited to die repair, the new tool would still be of great value to industry. Some examples will make this evident. A 12- by 8- by 2-inch die had been hardened when it was discovered that the rear side had to be formed to an 8-inch radius. This die had already cost $150, and had to be delivered immediately. It would have required more than four hours to grind off the excess material to a depth of 1 1/2 inches in the conventional way. Fortunately, modern contour machining facilities were available, and after installing the line-grinding band on the machine previously used to saw and file both punch and

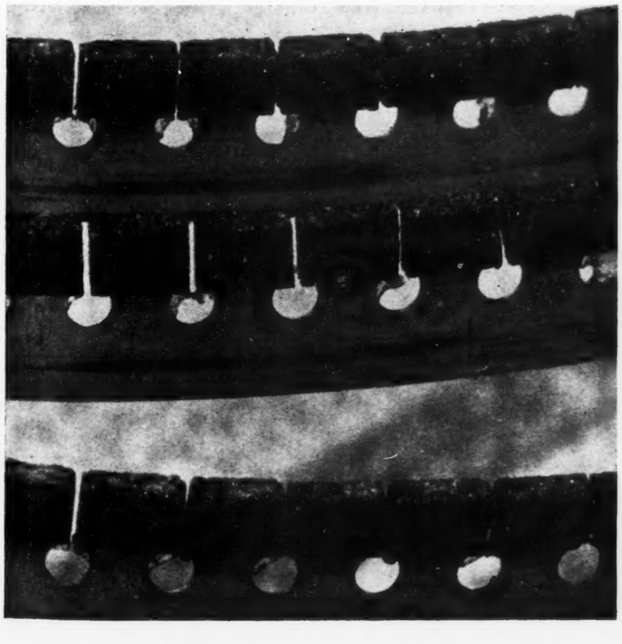


Fig. 1. Line-grinding bands are made of a special alloy metal to which aluminum-oxide or silicon-carbide "teeth" are welded

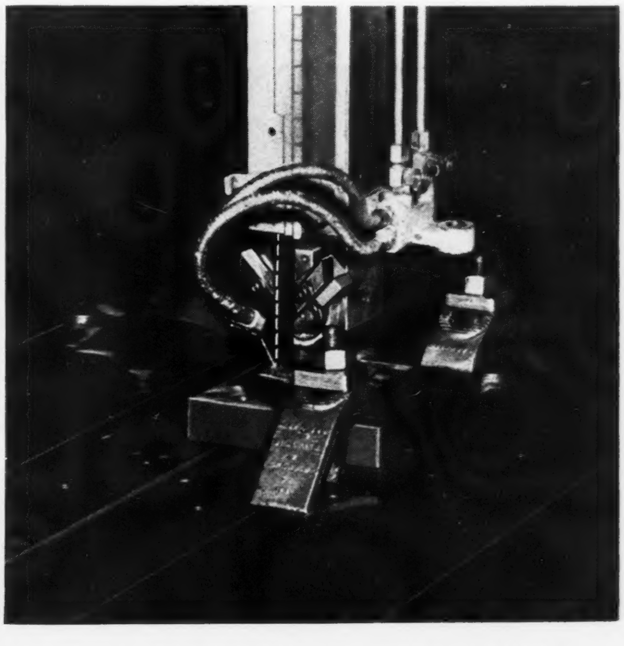


Fig. 2. Removing the broken section of a hardened tool-steel die by the line-grinding process in a Contour-matic band saw

die, the die error was corrected in twenty-five minutes. The saving effected on this one job equalled 75 per cent of the cost of the line-grinding band.

In another case, the broken section of a die made of oil-hardening tool steel, hardened to 59 Rockwell C, had to be removed. Approximately one square inch of material was removed in six minutes by line-grinding, as seen in Fig. 2, using a 60 to 1 mixture of high grade oil as a lubricant. The die with the broken section removed is shown at the left in Fig. 3, and the reconditioned die at the right.

A more complicated problem was encountered as the result of a change in a part due to heat-treatment. It happened that the keyways in a lot of gears, representing a value of $1500, had closed in heat-treating. As the delivery date was only two days off and there was no means of salvaging the parts, regardless of the time involved, the situation looked hopeless. However, it was learned that a tool and die shop not too distant had line-grinding equipment. The gears were immediately sent there, and the keyways were ground open. Moreover, the work was returned within twelve hours, ready to be shipped.

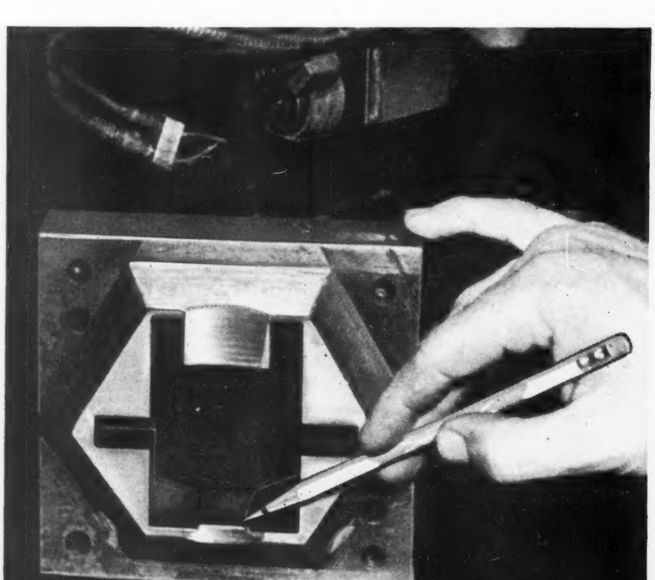
Mention that the line-grinding band is not a high-production tool does not imply that its cutting properties are exceedingly limited. It should be realized that the salvaging of these gears meant cutting the band, passing it through the hole, and butt-welding it for each part. This case is, of course, exceptional. Three blades had to be used for the job because after eight welds have been made in it, a blade becomes too short. Therefore, tool depreciation and welding time accounted for most of the repair cost. The rate of metal removal was 0.10 square inch per minute. This high rate of speed has been used even on such materials as high-chrome, high-carbon steel, hardened to 61 Rockwell C.

Another excellent application of the process is the separating of extremely hard machine parts for so-called "destructive" inspection. In one aircraft plant, engine cylinder heads are periodically cut open for inspection of the fit of Stellite valve inserts. It has been found, in this particular instance, that a silicon-carbide band performs efficiently all through the cut, whereas an aluminum-oxide band has a tendency to glaze rapidly when reaching the inserts.

This severe cut is accomplished in approximately 1 3/4 hours, and tool depreciation per cut is surprisingly low, compared to previous methods of performing this test. Line-grinding has two major advantages in respect to such inspection procedures—namely, the excellent finish obtained eliminates subsequent grinding, and the cool cutting action of the band preserves the original hardness or other physical characteristics of the part being cut.

A widely used material that is difficult to machine is Ampco bronze No. 24. In a large plant where a considerable amount of this material is used, friction sawing by the band process had been employed as much as possible, but since it was practical for no more than 15 per cent of the required applications, it did little to reduce high tool costs.

Although friction sawing on this type of material is three times faster than line-grinding, it is practical only on thicknesses up to 1/2 inch, and it does not permit radius cutting because of the excessive pressure required. Friction sawing



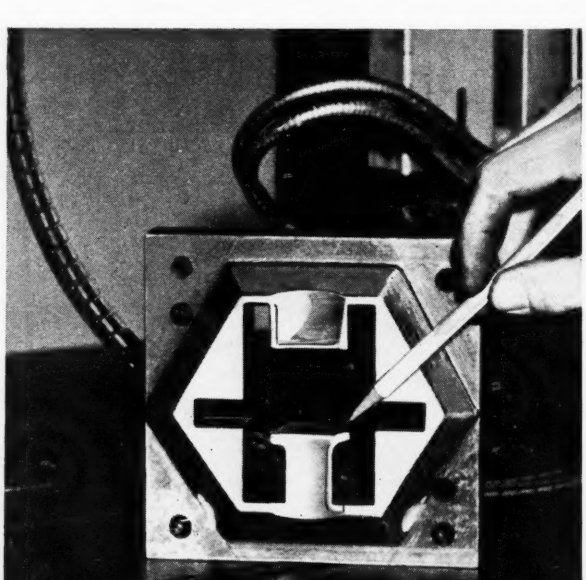


Fig. 3. (Left) Die with broken section removed, and (right) reconditioned die

is not a precision operation, since it produces a burr, and a certain amount of heat penetration takes place in the side walls of the cut.

Line-grinding is now used for most cutting operations on this material in the plant referred to, and is proving most efficient on all material thicknesses up to 3 inches. An average cutting rate of 0.10 to 0.20 square inch per minute is regularly maintained, and the blade life is often equivalent to 50 square inches of cutting. It is doubtful if a new conventional band could survive the cutting of 3 square inches of this material. The cutting rate would probably be the same for the first square inch, but would dwindle rapidly from then on.

Tests performed in conjunction with extensive research show that line-grinding bands function most efficiently at a velocity of 5000 to 6000 feet per minute, regardless of the nature and thickness of the material. Like a grinding wheel, the aluminum-oxide band requires occasional dressing with a small diamond; the silicon-carbide band automatically dresses itself through the natural breakdown of the abrasive.

The efficiency of line-grinding bands, and all other high-speed band tools for that matter, depends on the construction of the machine. Besides absolute rigidity, it is important to have hydraulic power with control over circuits that actuate post position, blade speed, blade tension, direction and speed of table stroke, and work-feed pressure. Moreover, a dependable cooling system is essential, by means of which the lubricant or coolant will be directed on the cutting edge of the band in the required volume.

* * *

New Spray-Forming Technique

A new spray-forming technique for fabricating large complex parts made of high melting point alloys, which are difficult to handle by conventional processes such as powder metallurgy, precision casting, or die forging, was developed in a research project made for the Navy Bureau of Ordnance by the Massachusetts Institute of Technology. The process consists of first spraying the metal on a core of the desired shape, and then sintering the sprayed deposit to form a dense, strong metal part. This provides a simple and inexpensive method of forming high melting point alloy parts.

Complete information on the process is given in Report PB 104 555, available from the Office of Technical Services, United States Department of Commerce, Washington 25, D. C., at $3.75 per copy in photostat form, and $2 per copy in microfilm.

Machining Aluminum on Automatic Screw Machines

Aluminum alloys are excellent materials for automatic screw machine operations because they can be machined at speeds of 700 surface feet per minute or higher and at feeds equal to or in excess of those used for most other metals. The "Technical Advisor," published by the Reynolds Metals Co., points out that the greater thermal expansion of aluminum means that in gaging, proper attention must be paid to the temperature, and consideration must be given to the contraction that will occur as parts cool.

Because of the expansion characteristic, taps and reamers should be on the high side of the tolerance range. Adequate support for the stock is essential in maintaining close tolerances, because of the greater deflection resulting from the low modulus of elasticity of aluminum.

In machining aluminum, there is the tendency to produce light, continuous chips. The use of hooks, chip coolers, or chip-breakers is often advisable to guard against chip clogging. The high machining speeds require provision for rapid disposal of chips.

High-speed steel tools are commonly used in machining aluminum in automatic screw machines, as their high abrasion resistance reduces wear and "down" time for resharpening operations. Carbon tool steels are used where tool breakage presents more of a problem than tool wear—for example, in the case of fragile tools for drilling and tapping.

All tools should have a good finish, and cutting edges should be kept sharp. Rubbing action should be avoided by the use of ample clearances. Carbide-tipped tools give a much longer life, but the carbide tip must have adequate support, which is not possible with all tool designs.

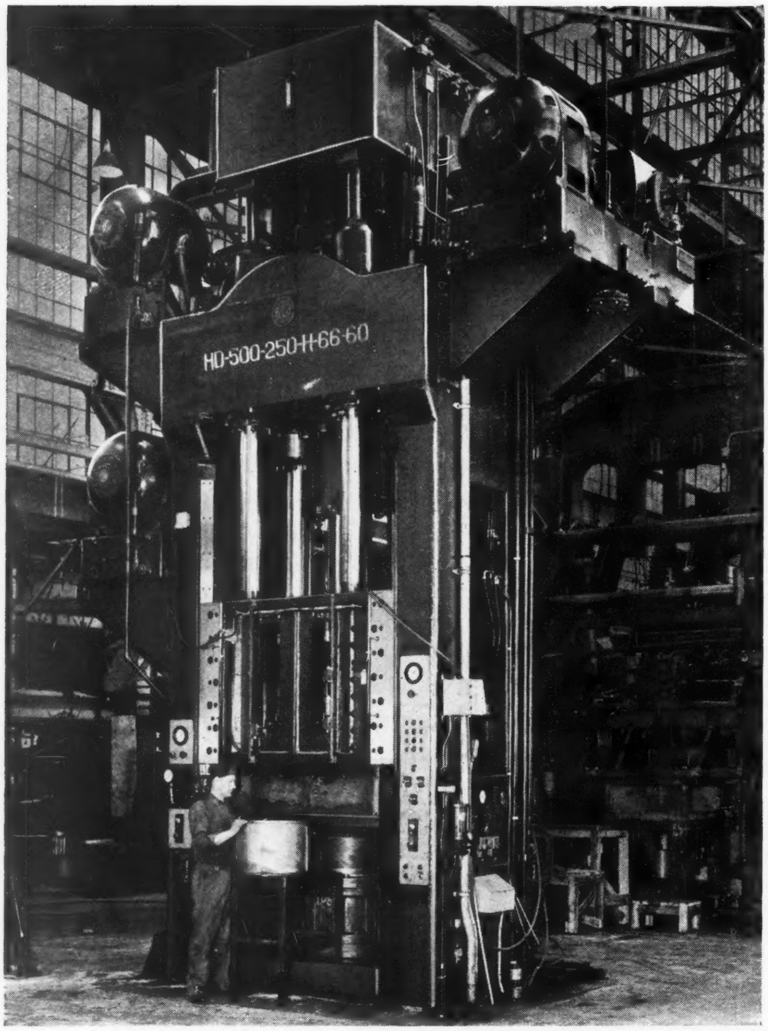
Carbide tools should be lapped to a mirror finish with a diamond lap for best results. Regardless of the type of tool, the surfaces over which the chips slide should be highly polished.

* * *

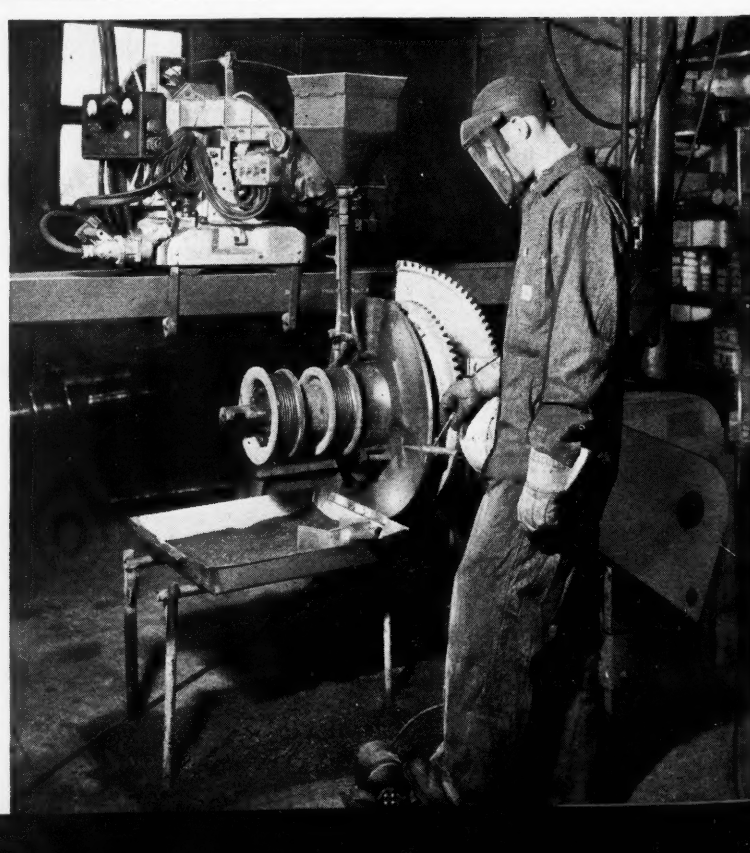
The executive secretary of the Engineering Manpower Commission of Engineers Joint Council, T. A. Marshall, Jr., has announced that over four hundred local representatives have been designated in all the forty-eight states of this country, as well as in Canada and the District of Columbia, for the purpose of "beating the drum" for the most complete industrial and military utilization of engineers, increased enrollment of students in engineering colleges, and fullest draft board consideration for this category of needed manpower.

In Shops Around the Country

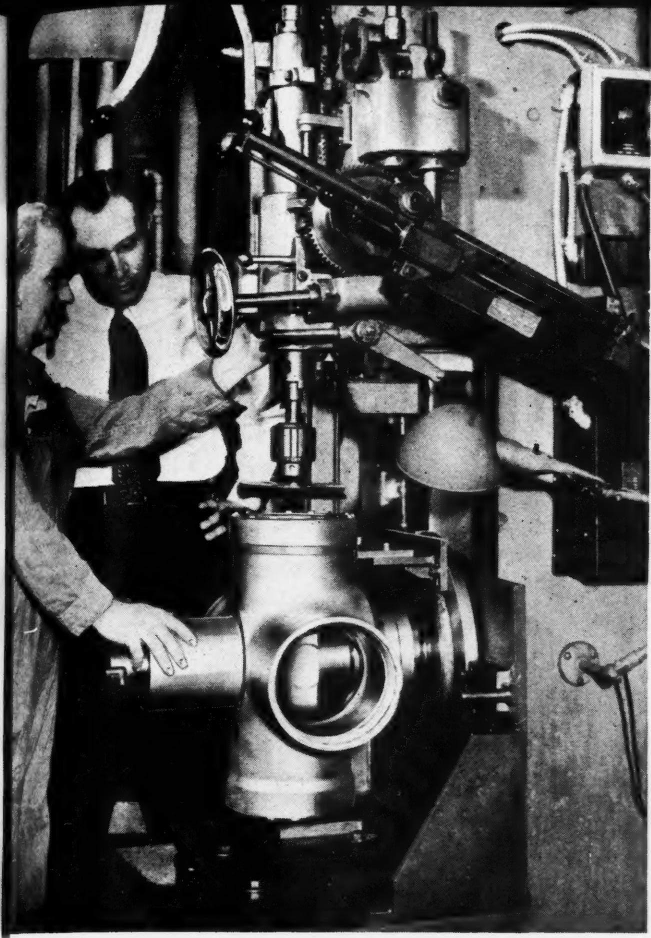
Camera Highlights of Some Interesting Operations Performed in Various Metal-Working Plants throughout the Nation



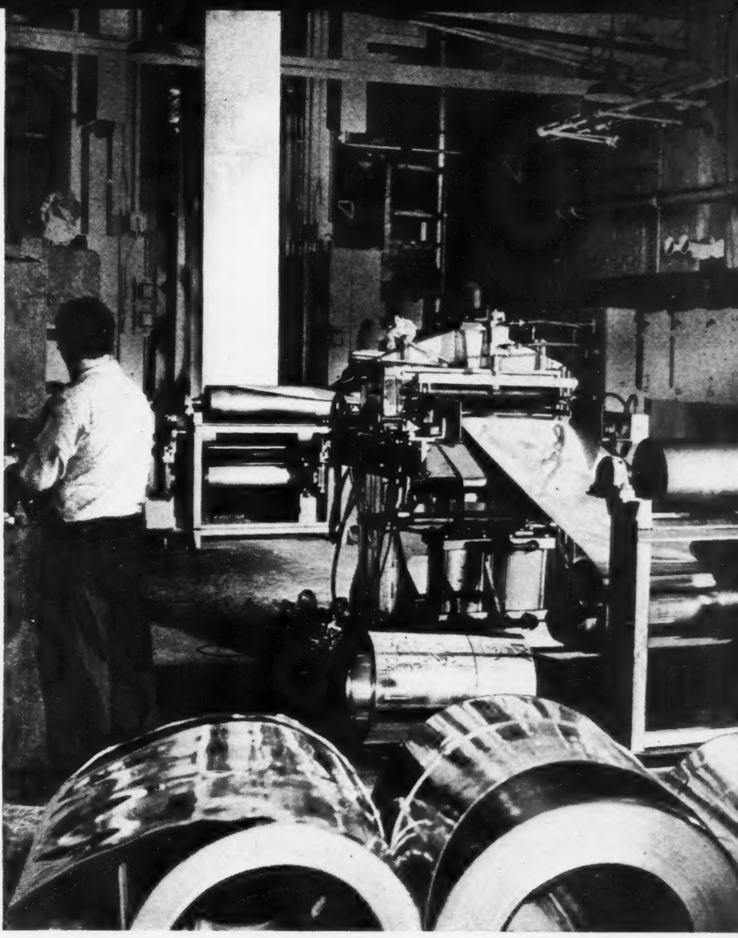
This Bliss double-action hydraulic press, employed at the City Auto Stamping Co., Toledo, Ohio, for deep-drawing washer tubs, has two drawing speeds in addition to its quick advance speed. The fast draw is accomplished with 250 tons pressure and the slow draw with 500 tons pressure. A pressure-switch safety feature prevents the plunger from descending until the blank-holder pressure has been registered on all four corners



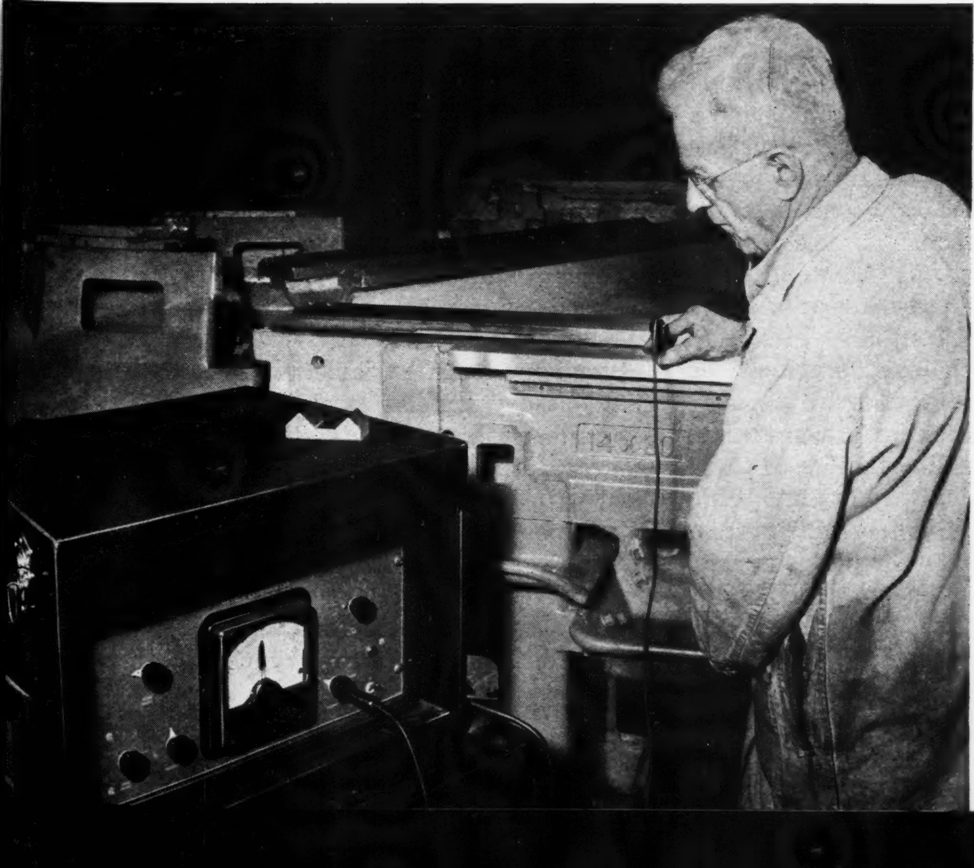
With the aid of a special work-positioner and a Unionmelt welding machine, the Alloy Hard-Facing Co., Minneapolis, Minn., is able to rebuild worn out tractor rolls in a fraction of the time usually required. The welding machine runs on a track above and parallel to the axle. Under normal conditions, one face of the 8 1/2-inch diameter roller can be rebuilt in about forty minutes, and it is necessary only to move the carriage a few inches from one face to start welding on the second face



An Osborn wire brush was mounted on a drill press equipped with an air-operated ram and timer to improve the finish of shot-peened bearing surfaces of propeller hubs. Nearly $20,000 in equipment costs and considerable time were saved by the Propeller Division of the Curtiss-Wright Corporation with this set-up

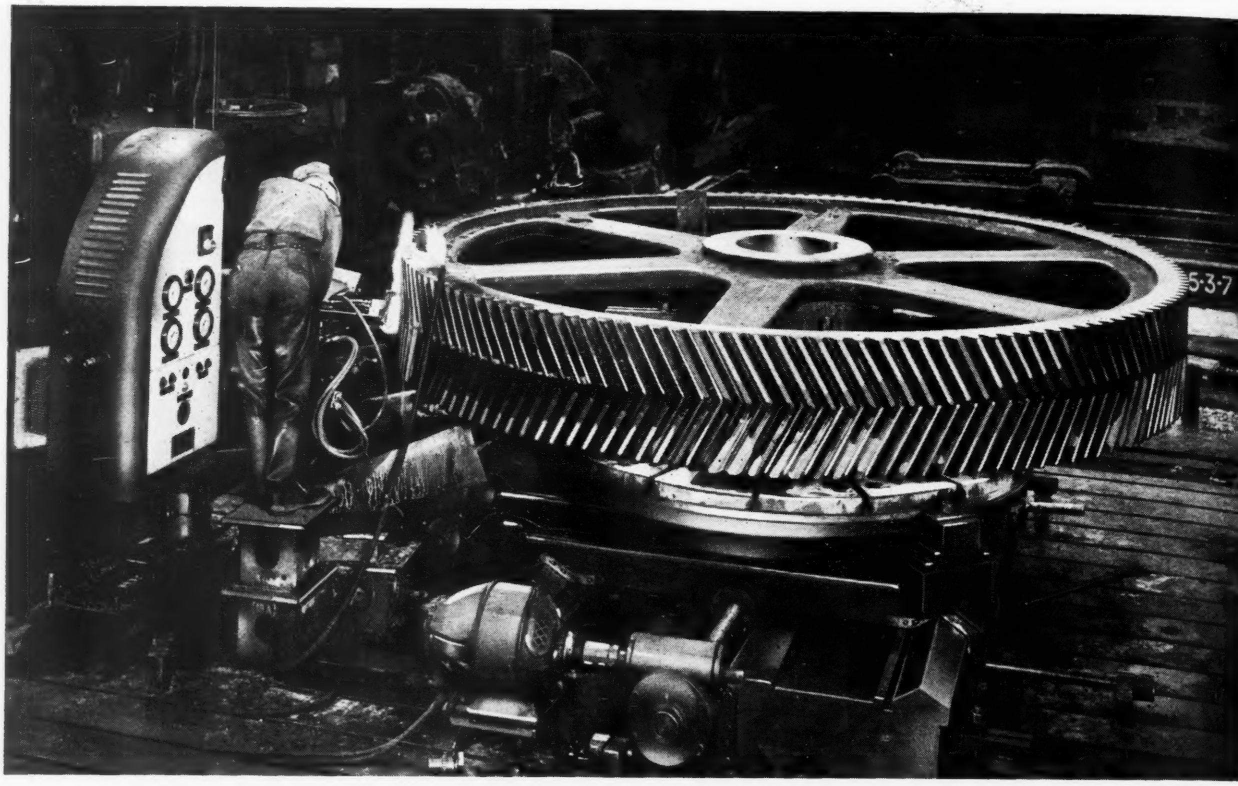


This large annealing and pickling installation is employed at the Waterbury, Conn., plant of the Chase Brass & Copper Co. to process 140,000 pounds of brass each day. A continuous flow of 25-inch wide sheet metal up to 0.040 inch thick passes through the furnace, which applies identical heat-treatment to the entire sheet



The hardness of a lathe bed way is here being tested with a General Electric metals comparator at the Hendey Machine Co., Torrington, Conn. A standard sample of metal is used to set the pointer of the comparator to zero. When the way is tested, the pointer indicates whether the bed is harder, softer, or the same as the master sample. No mark is left on the metal

Flame-Hardening—A Flexible



FLAME-HARDENING is a method of treating parts made from quench-hardenable material so as to obtain a hardened surface that is more resistant to wear than the original base metal. This is done by rapidly heating the surface of the metal with a gas flame, and then quickly quenching the heated area in a bath or stream of cold water.

The changes that take place in the metal result in a part having the highly desirable combination of a hard wear-resisting surface with a tough shock-resisting core. The wear-resisting surface —or flame-hardened case—is usually 1/8 to 1/4 inch deep. However, a case 1/16 inch deep can be obtained with certain techniques. Acetylene is generally used as the fuel gas. Combined with oxygen in a 1 to 1 ratio, acetylene produces a high-temperature flame of about 5600 degrees F. Sometimes oil is used for the quenching bath, or air may be employed to cool the heated parts.

Oxy-acetylene flame-hardening has proved to be a practical way of extending the life of thousands of steel and iron parts. In addition to being used in regular production-line jobs, this process is employed in many plants for job-lot parts. Some of the parts being flame-hardened today are sprockets, gears, sheaves, tractor treads, oil-well tool joints, dies, shear blades, bearing race-ways, cams, crane wheels, piston-rods, cross-heads, and saw blades.

Large parts that are difficult or impossible to harden in any other way can be easily handled by flame-hardening. For example, one of the first applications of this process was in the hardening of wabbler pads on the ends of large rolls used in rolling mills to give the pads a hard wear-resistant surface while retaining a tough ductile core. Another example of the ease with which large parts can be flame-hardened is shown in the heading illustration. Here a 35,000-pound herringbone gear, 12 feet in diameter, is being hardened by this process. Because of the size of the gear, the flame-hardening equipment was brought to the machine shop, thus eliminating the need for moving the gear to a heat-treating department.

Small areas can be flame-hardened by using a standard oxy-acetylene welding blowpipe to apply the heat, and quenching the heated spot with oil or water. Larger surfaces can be flame-hardened with heads designed to heat specific areas. This type of work can be done either with hand-operated or mechanized equipment. In the stationary method of flame-hardening, the blowpipe and the work are motionless.

In addition to the stationary method, there are

Method of Surface Treatment

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three other methods of flame-hardening, which are always performed by means of mechanized equipment. These methods—progressive, spinning, and combination flame-hardening—each have certain advantages for different sizes and shapes of parts.

In the progressive flame-hardening method, seen at the top in Fig. 1, the flames are moved across the area to be hardened, with the quenching medium following immediately behind. Generally the orifices through which the quenching medium is applied are built into the heating head.

Round pieces, such as small precision gears, are usually hardened by the spinning method, illustrated in the center sketch. The part to be hardened is rotated while the flames impinge upon it. The entire heated surface is then quenched by sprays or by immersion of the part in water or oil after the flames have been extinguished or withdrawn.

In the combination flame-hardening method, which is used on such parts as shafts, the spinning method is used for application of the heat, and the flames traverse the area to be hardened. The quench follows the flames and is applied continuously, as in the progressive method. A set-up for welding by the combination method is illustrated at the bottom of Fig. 1.

Advantages of Flame-Hardening

Flame-hardening often is the only method—or the only economical method—of hardening steel or iron parts. Here are some important advantages of this process:

1. Any size or shape of work can be hardened. Parts difficult to heat-treat in other ways because of size or shape, can be easily flame-hardened.

2. Distortion of parts in flame-hardening is far less than that produced by other methods, and is usually negligible. Because of this, many parts can be both rough- and finish-machined before the hardening operation, thus reducing production costs.

3. Valuable physical properties, such as toughness and ductility, are retained in the core of the metal, since the core is entirely unaffected by flame-hardening.

4. There is no change in the chemical composition of the metal, since only the structure of the hardened area is changed in flame-hardening.

5. Substitute or cheaper carbon steels can often be made to do the work of the more costly alloy steels.

6. Flame-hardened cases are of sufficient depth for most applications, and spalling conditions are absent.

7. The flame-hardening process is fast, some pieces being hardened in as short a time as five seconds. Also, as production is speeded up, costs go down.

8. Thin sections can be flame-hardened. The speed of heating by oxy-acetylene flames permits surface-hardening of sections as thin as 3/8 inch when proper techniques are employed.

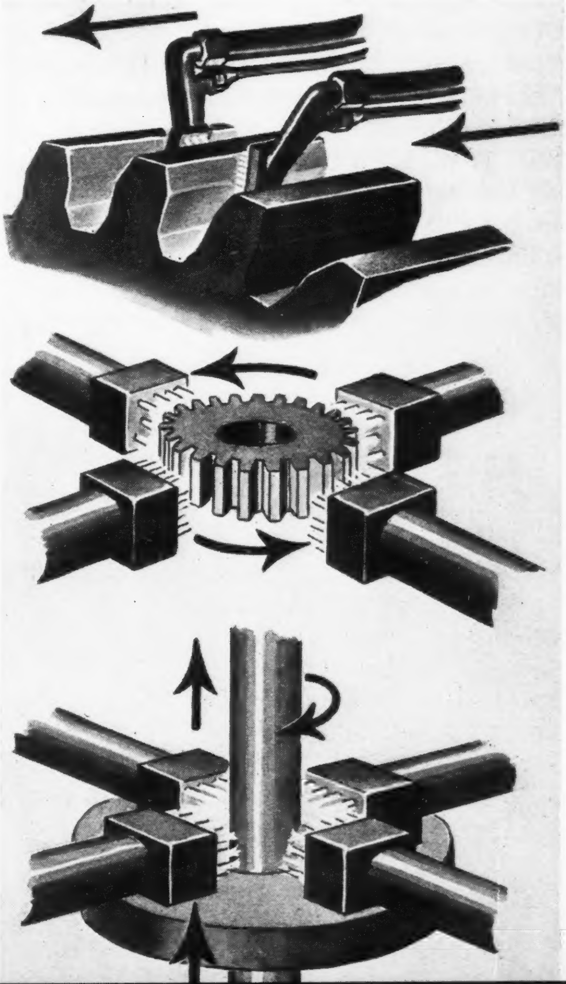

Fig. 1. Three oxy-acetylene flame-hardening methods. In the progressive method (top), the flames are moved across area to be hardened; in the spinning method (center), the work is rotated; and in the combination method (bottom), the work is rotated and the flames traversed

Analysis and Case Hardness of Some Materials

Material	SAE Numbers	Chemical Composition Range, Per Cent (Principal Elements)		
		Carbon	Manganese	Silicon
Carbon Steels	1035 to 1070	0.32–0.75	0.50–1.65	......
Manganese Steels	1335, 1340	0.33–0.43	1.60–1.90	0.20–0.35
Nickel Steels	2340, 2345	0.38–0.48	0.70–0.90	0.20–0.35
Chromium-Molybdenum Steels	4140 to 4150	0.38–0.53	0.75–1.00	0.20–0.35
Nickel-Molybdenum Steel	4640	0.38–0.43	0.60–0.80	0.20–0.35
Chromium Steels	5140 to 5150	0.38–0.53	0.70–0.90	0.20–0.35
Chromium-Vanadium Steel	6150	0.48–0.53	0.70–0.90	0.20–0.35
Carbon-Vanadium Steel	......	0.45–0.55	0.60–0.90	0.20–0.35
"Cromansil" Steel	......	0.30–0.45	1.00–1.30	0.70–0.90
Manganese-Molybdenum Steels	......	0.33–0.43	1.60–1.90	0.20–0.35
Cast Irons*	......	0.50–0.70 (Combined)	......	......

*With or without alloy additions.
†Hardness figures are for water-quenched materials.

9. Selective hardening of only those portions of the part subject to wear is easily accomplished with flame-hardening. For example, only the threaded portion of a large hold-down screw for a rolling mill is being treated in the flame-hardening operation seen in Fig. 3. In this set-up, the screw is rotated by holding one end in the chuck of a lathe. The blowpipe is mounted on the lathe carriage and traversed along the thread.

Steels that Can be Flame-Hardened

In general, any type of hardenable steel, including stainless steel, can be flame-hardened if proper procedures are followed. The degree to which plain carbon steels can be quench-hardened is dependent upon the carbon content of the steel. To obtain a reasonable increase in hardness, the steel should contain at least 0.35 per cent carbon. As the carbon content increases, the hardness obtainable increases. The general range for plain carbon steel is from 0.35 to 0.50 per cent carbon. Steels with greater carbon percentages can be flame-hardened, but more care is required to prevent surface checking.

The most desirable steels for flame-hardening are straight carbon or quench-hardenable steels. These usually harden to a good degree, and, except for certain types, will generally withstand heating and water quenching without checking or cracking. Higher alloy steels require different heating and quenching techniques, and must be considered individually. Some of these steels can be hardened adequately by an air quench or a combination of air and water quench.

The accompanying table gives the analysis of some materials suitable for flame-hardening. The hardnesses shown in this table, obtainable in the heat-treated surface, are largely dependent upon the carbon content of the material. The materials listed are not the only ones suitable for flame-hardening, but are given as examples of those satisfactory for the work.

When steel is heated well into the red-heat range, the carbon in the steel goes into solution uniformly throughout the mass, thus changing

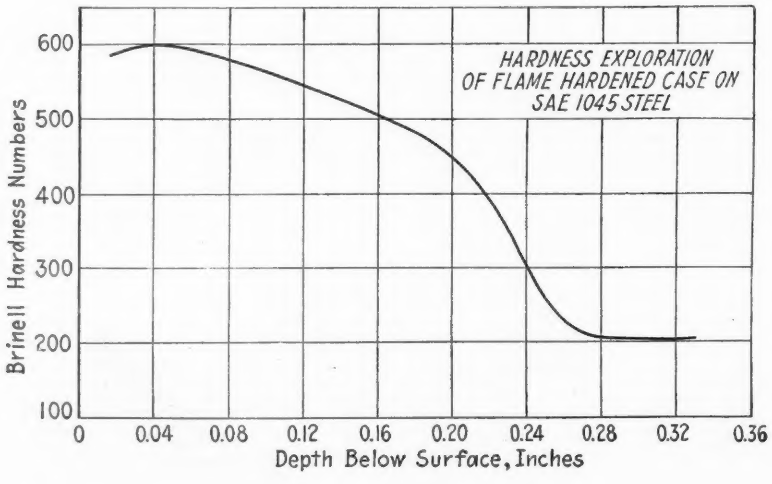

Fig. 2. Typical hardness gradient, indicating the Brinell hardness at various depths below the surface of a flame-hardened case on S A E 1045 steel

Suitable for Flame-Hardening

Chemical Composition Range, Per Cent (Principal Elements)				Case Hardness†	
Nickel	Chromium	Molybdenum	Vanadium (Minimum)	Scleroscope	Brinell‡
......	......	......	....	50–90	350–700
......	......	......	....	75–90	550–700
3.25–3.75	......	......	....	70–80	500–600
......	0.80–1.10	0.15–0.25	....	70–85	500–650
1.65–2.00	......	0.20–0.30	....	70–80	500–600
......	0.70–1.15	......	....	70–85	500–650
......	0.80–1.10	......	0.15	75–85	550–650
......	......	......	0.15	70–90	500–700
......	0.40–0.60	......	....	75–85	550–650
......	......	0.15–0.25	....	75–85	550–650
......	......	......	....	60–80	450–600

‡Hardness determinations on flame-hardened parts should be made with the scleroscope or the superficial Rockwell hardness tester. The Brinell numbers shown here have been converted.

the structure of the steel. If the heated mass is then allowed to cool to room temperature at a slow enough rate, the carbon comes out of solution again to form almost the same structure as before heating. This structure is relatively soft. However, if the heated mass is cooled rapidly or suddenly, as in the flame-hardening process, the metal does not have time to become soft. Instead, a very hard, permanent constituent—martensite—is formed.

In flame-hardening, there is no change in the chemical analysis of the material and no sharp demarcation between the hardened zone and the softer core, as is found in casehardened work. This is due to the temperature gradient which exists in the metal during heating, and results in a gradual transition zone from the hard structure at the surface to the original unaffected structure in the core. Fig. 2 shows a typical hardness gradient, indicating the Brinell hardnesses at various depths below the surface on a flame-hardened part made from S A E 1045 steel.

The increased toughness resulting from this physical condition, combined with high hardness, accounts for the successful wear resistance of parts that have been given this treatment. The hardened zone produced is at least two or three times the depth of that usually obtained by carburizing, and it will not spall, check, or crack when subjected to impact, vibration, or deformation. Since only the metal from 1/16 to 3/8 inch below the surface will be hardened, the balance of the metal is in a soft condition, with a minimum of stresses in the core.

A set-up for flame-hardening the ways of lathe beds is seen in Fig. 4. By this method, the hardness of the ways is increased from 35 to about 70 scleroscope, and reconditioning of the ways is seldom required to re-establish alignment. Flame-hardened lathe-bed ways have been in use for ten years without showing signs of wear.

Arrangements for quenching flame-hardened parts are easy to set up. In many operations, a small stream of water sufficient to cover the area

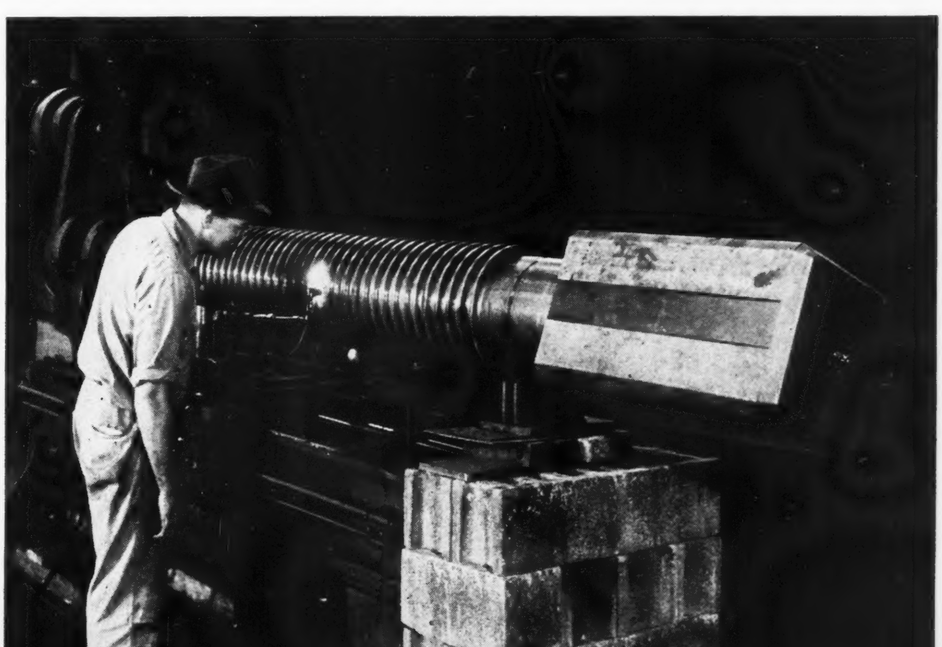

Fig. 3. Threaded portion of a rolling mill hold-down screw is selectively hardened in this set-up. One end of the screw is held in the chuck of a lathe, and the blowpipe is mounted on the carriage

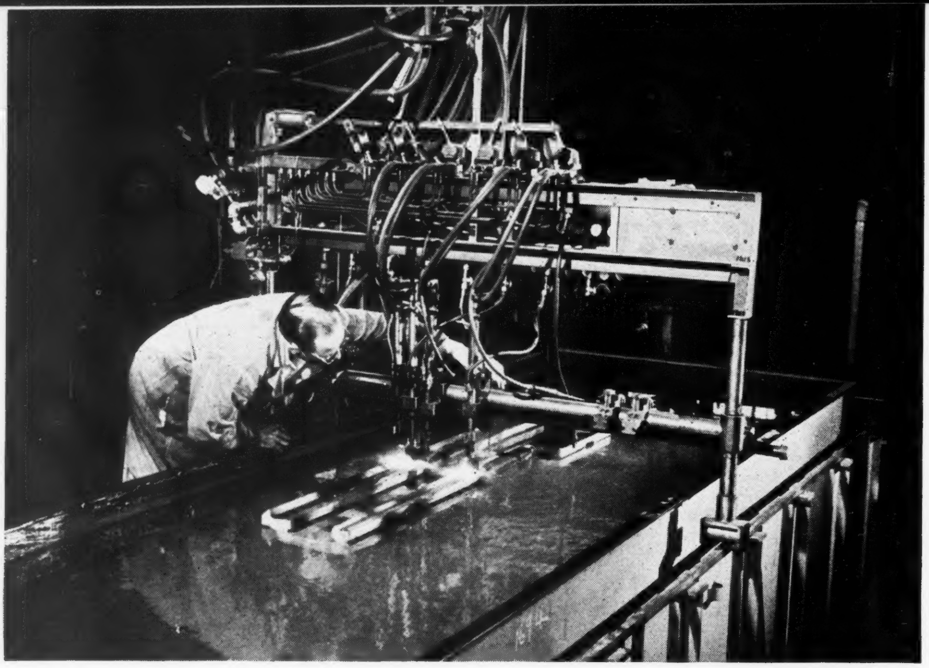

Fig. 4. Hardness of lathe-bed ways is increased from 35 to 70 scleroscope in this flame-hardening operation. Scraping of the ways is not required

to be hardened is all that is necessary. Fig. 5 illustrates the flame-heating and water-quenching set-up employed for hardening cast sheaves by the spinning method. Where a wider path must be covered by the water, a fan-shaped nozzle or spray can be used. Either of these is simple to make or obtain.

For progressive work, the pipe carrying the quenching water should be affixed to the blowpipe holder in such a way as to permit the necessary adjustment to direct the stream properly on the hot steel. The quench should follow the last flame closely, but without interfering with the flames. The quench stream is usually adjusted to trail the flame by about 3/4 inch.

For many spinning operations in flame-hardening small parts, it is advisable to use a quenching method by which a large volume of water under low pressure can be released to cover the entire part instantaneously and flow over it in a solid stream for the necessary length of time.

It is desirable to follow the flame-hardening and quenching operations by a stress-relieving or drawing treatment. This is simply a reheating operation that prevents checking and minimizes distortion. If conducted at a temperature between 350 and 400 degrees F., the drawing operation has little if any effect on the hardness. The article can be cooled in still air. A flame-hardened part can also be tempered to reduce the hardness if desired.

Flame-hardening is an economical process. Oxygen and acetylene at the rate of 0.20 cubic feet per square inch of surface area will harden to a depth of 1/4 inch. For a 1/8-inch heat-affected zone, oxygen and acetylene consumption will be at the rate of about 0.14 cubic feet per square inch of surface area to be hardened.

The close control of case depth and the selective hardening of only the wear portions of the part are generally accomplished more easily and with less cost than with other methods of

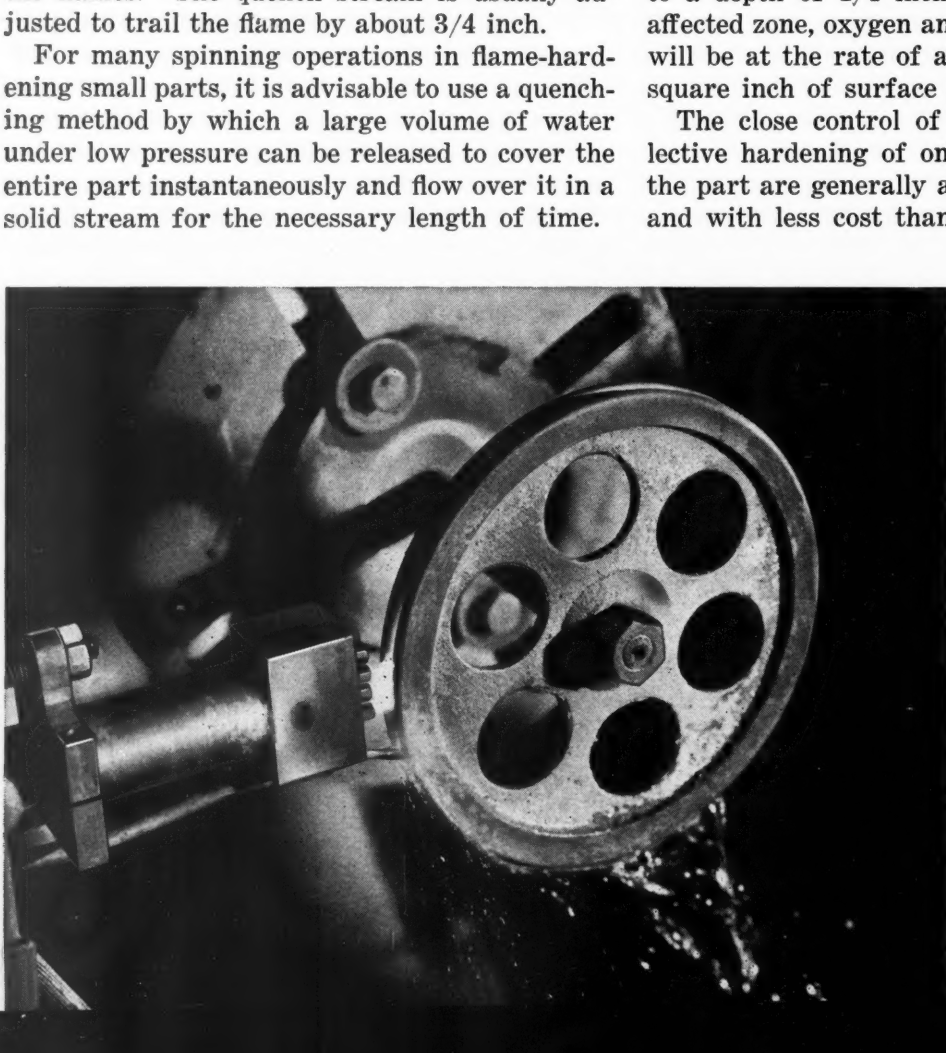

Fig. 5. The surface of a cast sheave is flame-hardened by the spinning method. A stream of water quenches the metal immediately after it has been heated by the flames

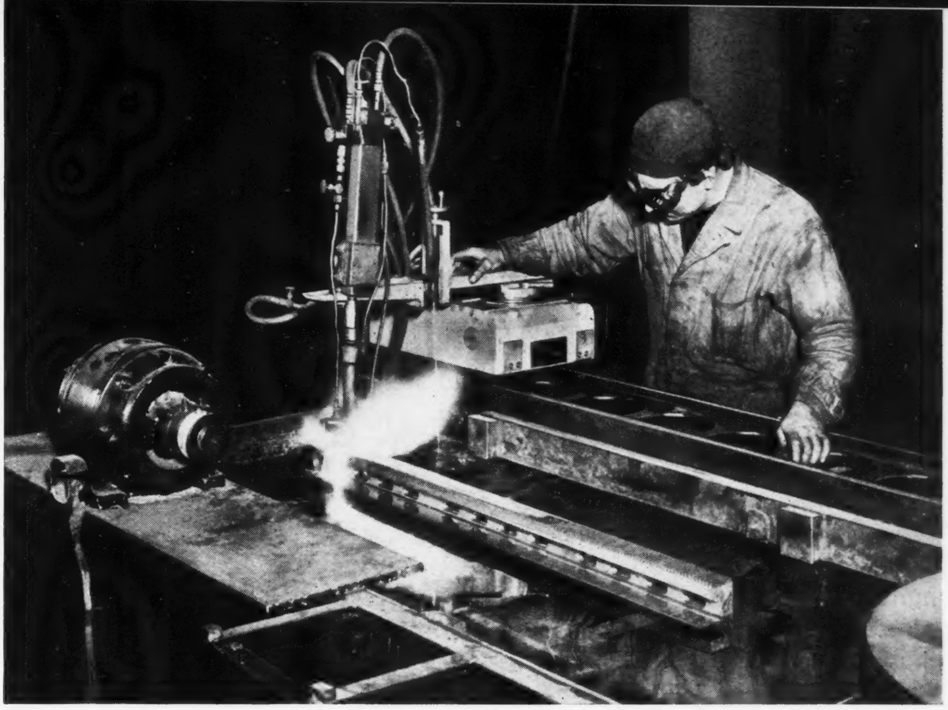

Fig. 6. Standard oxy-acetylene cutting machines can be equipped with flame-hardening apparatus and used for progressive hardening operations

heat-treatment. Investment in additional equipment is moderate. Many parts can be flame-hardened on commonly available machines, such as lathes, if a suitable heating head and blowpipe are substituted for the cutting tool. For progressive hardening, it is often convenient to mount the flame-hardening apparatus on a standard oxy-acetylene cutting machine, as seen in Fig. 6.

Flame-hardening heads are designed in many shapes and sizes to suit a wide variety of parts having flat, round, or irregular surfaces. The heads fit standard oxy-acetylene welding blowpipes. To accommodate various widths, as well as irregular profiles, the tips are of the threaded removable type, and are obtainable in different lengths and with various size orifices.

Straddle type heads for the flame-hardening of gear teeth are mirror images of each other, so that both sides of each tooth are hardened simultaneously. The flame tips on these heads are especially spaced to produce the desired hardness contour. Arrangements for quenching are built into such heads. The teeth of a large herringbone gear are shown in Fig. 7 being flame-hardened with such equipment. It is generally impractical to harden gears of this size in any other way.

* * *

Approximately 230,000,000 gallons of water daily—enough to supply two-thirds of the needs of nearby Philadelphia—will be pumped for all services at the U. S. Steel Co.'s new Fairless Works at Morrisville, Pa. Distribution networks will require about 25 miles of steel, cast-iron, and concrete pipe ranging in size from 6 to 72 inches in diameter, and another 25 miles or more of pipe under 6 inches.

Fig. 7. The teeth of large gears are hardened easily and economically by means of oxy-acetylene flames. Straddle type flame heads harden both sides of a tooth simultaneously

Which Seal for What Service?

By E. P. STAHL
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ONE of the most important factors in securing optimum service from bearings, whether they are of the anti-friction or the plain sleeve type, is the selection of the means for sealing and protecting them from extraneous matter and contamination. Entrance of foreign matter into the bearing can seriously impair its performance and greatly shorten its life. This is particularly true of ball and roller bearings. It is estimated that more than 90 per cent of anti-friction bearing failures are directly traceable to the entrance of foreign matter into the bearings.

Substances most likely to impair proper performance can be divided into three general classes—abrasives, such as grit, dust, and sand; foreign materials, such as iron, brass, and steel chips; and corrosive agents, such as acids, water, and moisture. In order to protect bearings against the entrance of such materials, and also to retain lubricant in them, various types of seals and closures are available. A few of the more common types will be discussed in this article.

No one seal or closure is equally effective in all cases. Each application must, therefore, be appraised in the light of its own operating condition, and the seal or closure selected that best meets the service demands. The choice of a seal in many cases lies between several different types. For instance, a seal that is effective in excluding dirt from a bearing may be ineffective in excluding moisture, and vice versa. Also, a particular unit type seal might work satisfactorily when operating at a surface speed of 2000 feet per minute under no pressure, but might fail in a short time when subjected to a small amount of pressure. The same seal, again, might fail under no pressure by having too much eccentricity. The purpose of this article is to help the machine designer put the right type of seal in the right place.

Simple Felt Seals Act as Oil Reservoirs

The types and kinds of seals and seal combinations are too numerous and too diverse to cover fully here; but an explanation of the construction and sealing action of a few of the more common types may be useful to the machine designer. One of the commonest and most popular types of contact seals used with both anti-friction and plain sleeve type bearings is the felt ring or washer, which may be purchased as a finished part or produced by the user. In this type seal, the felt acts as an oil reservoir, wiping oil on the shaft.

Felt seals, accurately cut and properly fitted to a bearing housing or bearing end cover, are effective under a considerable variety of operating conditions, including a wide range of speeds. Normally, felt seals are not operated at surface speeds in excess of 2000 feet per minute. However, speeds as high as 4000 feet per minute have been attained with these seals in cases where shafts are hard and smooth, and there is ample lubricant in the seal area.

Many anti-friction and plain sleeve type bearings are protected from the ingress of dirt, grit, or moisture and the leakage of oil and grease by means of felt seals. Felt seals are now available

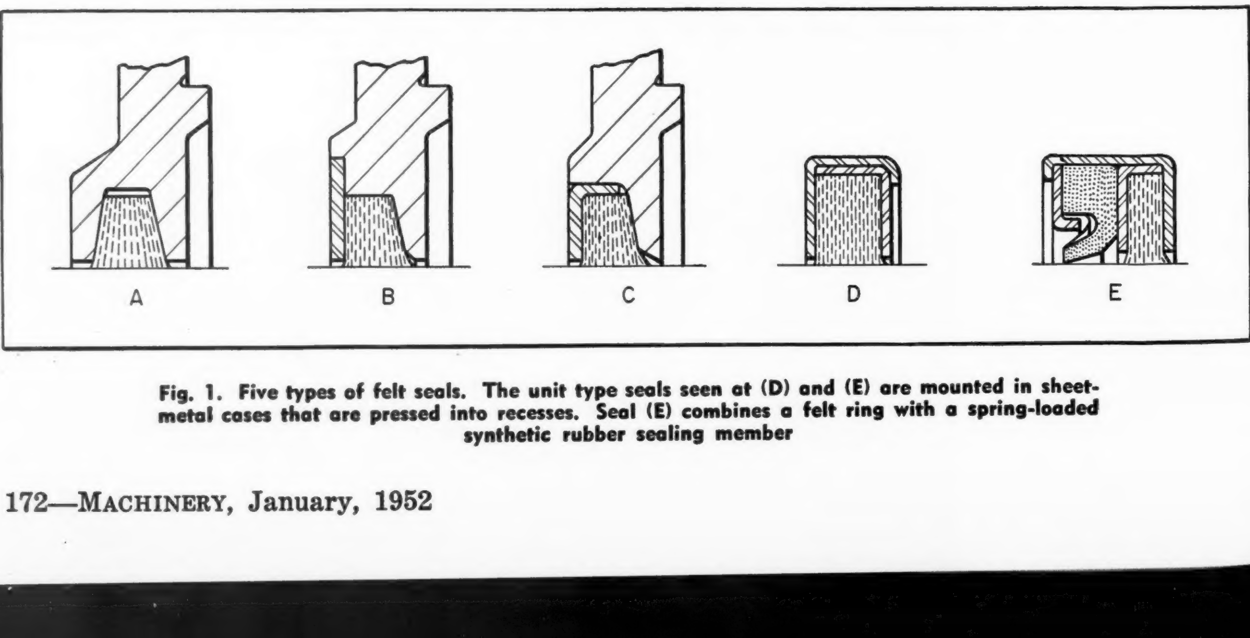


Fig. 1. Five types of felt seals. The unit type seals seen at (D) and (E) are mounted in sheet-metal cases that are pressed into recesses. Seal (E) combines a felt ring with a spring-loaded synthetic rubber sealing member

combined with other materials, such as synthetic rubber, to keep oil from passing through the felt. In this way, a combination laminated seal material can be evolved having felt properties and also impermeability features.

Felt seals can be mounted either in cored or machined carriers or in self-contained cases or shells, as illustrated in Fig. 1. At *A* is shown a simple felt ring mounted in a machined or cored recess. The seal has double tapered sides without compression. This seal arrangement has been used extensively with ball and roller bearings when grease lubrication is employed.

In the design shown at *B*, a felt ring is mounted in a machined recess having a taper on its back face. A removable retaining plate greatly facilitates assembly and disassembly of the ring. A felt ring mounted in this manner causes the fibers to bear down on the shaft in such a manner as to round the sealing surface, thus providing compression for a long time because of the natural resilience of the wool fiber. Such seals have been used satisfactorily with ball and roller bearings to retain both oil and grease lubricants.

Another felt ring mounted in a recess with a tapered back end is seen at *C*. In this case, a cupped metal stamping or retainer, pressed into the machined recess, holds the ring in place.

A unit type felt seal consisting of a felt ring mounted in a metal case, designed so that it can be pressed into a seal recess, is illustrated at *D*. Seals of this type are available in a variety of sizes, interchangeable with commercial spring-loaded unit type leather and synthetic rubber seals, which will be discussed later.

Another unit type seal, which consists of a felt ring combined with a spring-loaded, synthetic rubber sealing member, is seen at *E*. Spring-loaded seals are also available with leather sealing members. In this construction, the felt ring is applied on the outside, farthest away from the bearing. The reason for this is that while the felt is efficient in excluding dirt, it is also saturated with oil, thereby acting as a reservoir which supplies lubricant as needed both for the inner sealing member and itself. If correctly fitted, the natural resiliency of the felt assures effective sealing for a considerable length of service.

These combination felt type seals are available as purchased units in a variety of sizes, and are interchangeable with commercial spring-loaded, unit type leather and synthetic rubber seals.

It is important that the user recognize the limitations of felt seals. For example, they should not be expected to retain light lubricant efficiently. As a matter of fact, felt seals are often used in cases where some of the lubricant is expected to escape in order to wash away particles of dirt. On the other hand, if the dirt condition is severe, the dirt will get under the felt and act as an abrasive, forming grooves in the shaft.

As with other contact seals, the surfaces on which felt seals operate should be hard and smooth, and, whenever possible, there should be ample lubricant in the seal area to guard against grooving of the shaft. The eccentricity limits and operating speeds for felt seals should be relatively low.

Metal Labyrinth Type Seals Can Operate Over Wide Range of Speeds

The seals illustrated in Fig. 2 are of the metal labyrinth type. These seals are of the non-rubbing, clearance design, consisting of a rotating and a stationary metal ring with flanges so designed that the two rings fit closely over a wide area, thus forming a tortuous path for the lubricant. This provides a change of direction for the lubricant, and serves to retain it in the bearing. Centrifugal force also plays a role in this action. Such labyrinth seals have been used successfully with both grease and oil, at low, medium, and high speeds, to seal both ball and roller bearings.

There are two main types of labyrinth seals—the axial type seen at *D* in Fig. 2, and the radial

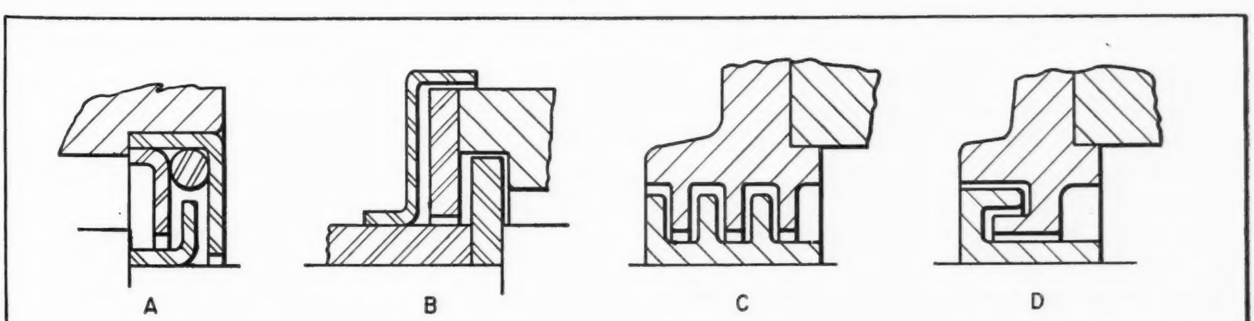


Fig. 2. Metal labyrinth type seals contain a rotating and a stationary flanged metal ring that form a tortuous path for retaining the lubricant. Radial type labyrinth seals are seen at (A), (B), and (C), and an axial type at (D)

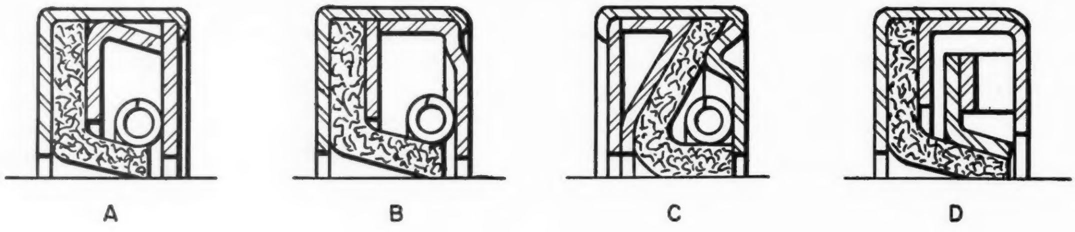


Fig. 3. Single unit type spring-loaded leather seals. A leather seal, held against the shaft by a garter spring, is used in the designs seen at (A), (B), and (C), while a spring-cushioned metal washer or serrated type finger spring is used in the design illustrated at (D)

type shown at *A*, *B*, and *C*. These seals can be made from simple metal stampings (like the design seen at *A*) or from machined parts (like the designs shown at *B*, *C*, and *D*). Labyrinth seals are often used with supplementary closure parts, such as slingers, felt rings, and capillary grease grooves, to increase their effectiveness. The design illustrated at *B* is a simple radial type labyrinth seal, mounted in combination with a slinger. Slingers are often used to deflect dirt and chips away from the path of the bearing.

The design at *A* is a four-part radial labyrinth seal made from metal stampings to retain grease in the bearing and to guard against the ingress of dirt, grit, and water. The radial type labyrinth seal shown at *C* is made from machined parts. This type of construction is generally used with a housing or bearing end cover of split design.

The axial type labyrinth seal at *D* consists of two machined parts. Closures of this type are generally used for various kinds of high-speed machine tool spindles where the bearings are oil lubricated, and shaft eccentricity and other tolerances are held to very close limits. In applications of this kind, a small amount of oil leakage outward from the bearing housing is beneficial in that it carries the abrasive matter away and keeps relatively fresh lubricant between the closure members as a sealing medium.

Although relatively expensive, due to the accurate machining and mounting required, both axial and radial type labyrinth seals are extensively used with ball and roller bearings. This is probably due to the fact that they can be operated over a wide range of speeds, and are practically indestructible and frictionless.

Unit Type Spring-Loaded Leather Seals

Another common seal is the unit type fabricated leather and synthetic rubber seal, sometimes designated the lip type, flange type, or unit seal. Such seals are furnished in regular or external types, mounted in the housing or on the shaft. This description will be confined to those pressed into the housings. These unit type seals are available in a variety of sizes, and equipped with either spring-loaded sealing members or non-spring-loaded units.

Under normal operating conditions, where seal operating surfaces are hard and smooth and there is ample lubricant in the seal area, differences in the performance of the unit type spring-loaded leather seals shown in Fig. 3 are not critical. The designs seen at *A*, *B*, and *C* comprise leather seal structures with garter springs, whereas that shown at *D* incorporates a spring-cushioned metal washer or serrated type finger spring.

Spring-loaded unit type leather seals are suitable for general-purpose applications, including automobiles, tractors, farm implements, and a variety of industrial assemblies. Operating limitations include a maximum temperature of 200 degrees F., and a speed not exceeding 2000 feet per minute. These seals should not be used where shaft run-out is high.

Unit Type Synthetic Rubber Seals

Unit type radial synthetic rubber seals, shown in Fig. 4, are similar in appearance and structure to unit type leather seals, and are available in sizes that provide interchangeability with leather seals. Under normal operating conditions, differences in the performance of unit type synthetic rubber seals, compared with unit type leather seals, are not critical.

A unit type synthetic rubber seal equipped with a serrated type finger spring is shown at *A*. The designs seen at *B*, *C*, *D*, *E*, *F*, and *G* are unit type synthetic rubber seals equipped with garter springs. A thin cross-section, unit type synthetic rubber seal, designed to be a press fit in the same housing bore that receives narrow cross-section

needle bearings and sleeve bearings is seen at *E*. No additional counterbore is necessary to seat this type of seal.

The design shown at *F* is a spring-loaded, non-metallic, caseless seal of molded construction, while that seen at *G* is a spring-loaded, unit type seal with a relatively soft outside diameter. The entire outer covering in the latter design is permanently fused to a rugged steel truss. This type seal, as well as that shown at *F*, has a particular advantage in its ability to form a perfect closure at the outer periphery. Also a less critical housing bore is required with such seals.

Spring-loaded, unit type, synthetic rubber seals are suitable for general-purpose uses, including tractors, automobiles, engines, transmissions and pinions, as well as a variety of industrial assemblies. Operating conditions include a maximum temperature of 250 degrees F., and speeds of over 2000 feet per minute. These seals must be used with well finished shafts, and should never be applied where lubrication is absent or scanty.

In many applications, synthetic rubber is preferable to leather because it permits higher temperatures and peripheral speeds and affords better sealing against various kinds of organic and inorganic substances. This does not mean, however, that synthetic rubber is superior to leather in every respect. In fact, leather sealing members offer certain advantages. For example, they require less lubrication and smaller finished surfaces on the shafts than synthetic rubber seals. When lubrication is less satisfactory or scanty, a leather sealing member should be employed. Other factors are important in selecting the right type of sealing member, and when in doubt, the advice of the seal manufacturers should be obtained.

Unit Type Seals with Double Leather or Synthetic Rubber Sealing Members

In addition to the single design of leather and synthetic rubber seals, unit type seals are available with double sealing members, as shown in Fig. 5. The designs illustrated have leather sealing members, but similar structures can also be obtained with synthetic rubber sealing members.

The design at *A* combines a spring-loaded leather sealing member with an auxiliary leather dirt-and-water exclusion member. This type seal is preferably used where the shaft is assembled against the lip of the primary sealing member. A dual type seal with the auxiliary sealing member directed axially toward the spring-loaded member is seen at *B*.

The design illustrated at *C* is a unit, dual type seal employing an auxiliary sealing member as a shield or baffle for the primary spring-loaded sealing member. Such seals are used under extreme abrasive and dirt conditions where a mixture of fluid and abrasives is to be excluded, as in disc plows, crushers, and steel mill equipment.

A unit, dual type combination leather and felt seal employing felt on the exposed face to act as an exclusion agent is seen at *D*. This type seal is generally used in dust-laden atmospheres. The design at *E* is a unit, dual type seal with two opposed spring-loaded sealing members within a single unit for the separation and retention of two fluids. It is recommended for use in gear-

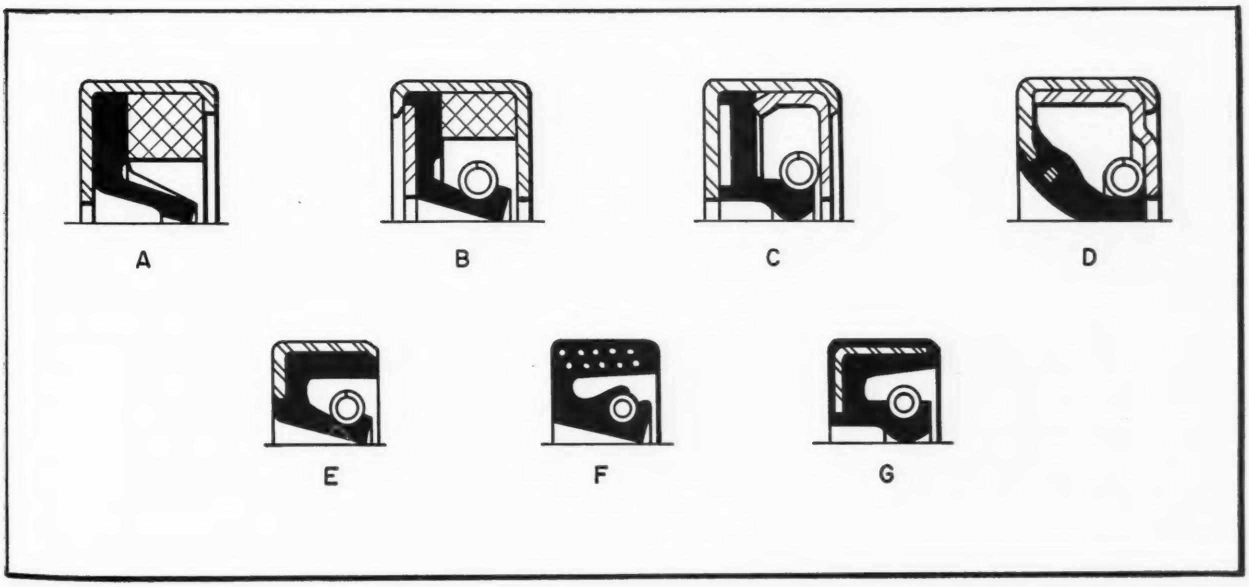


Fig. 4. Single unit type snythetic rubber seals can operate at temperatures up to 250 degrees F. and at speeds of 2000 feet per minute or more. The design seen at (F) is a spring-loaded non-metallic seal of molded rubber construction

boxes, chain drives, and other applications where two types of lubricants are employed, or where one sealing member must retain oil and the other exclude water or other extraneous matter.

Regardless of whether leather or synthetic rubber is used in this type of seal, it must be lubricated in some manner from both sides. If this cannot be done, two single seals, mounted in reverse tandem, with provision for introducing lubricant between them is preferable.

A unit, dual type seal having two spring-loaded sealing members mounted in tandem within a single metal case is seen at *F*. This special seal is adapted for difficult sealing applications, as, for example, where the seal operates in a vertical position under a head of oil or where extreme abrasive conditions are encountered, in which case the second sealing member helps to keep the abrasive from the primary member. In the latter case, the seal is mounted in the housing with its lips pointed away from the part being sealed. Such seals are used on machine tools, track rollers of tractors, disc plows, crushers, and excavating machinery where difficult exclusion problems prevail.

If the two sealing members cannot be adequately lubricated, it is preferable to use two single unit type seals in tandem, with provision for introducing lubricant between them.

Seals of this type, with double sealing members of leather or synthetic rubber, should not be operated at too high a speed or temperature because the auxiliary sealing member tends to increase the heat of the operation. Temperatures during operation should not exceed 180 degrees F. for leather sealing members or 200 degrees F. for synthetic rubber. Surface speeds should not exceed 2000 feet per minute for the designs illustrated at *A*, *B*, and *C;* 1500 feet per minute for that at *D;* and 1000 feet per minute for the designs at *E* and *F*.

Springless Unit Type Seals are Economical and Can Fit in Limited Spaces

Springless unit type oil and grease seals are recommended for extremely limited designs, where space is constricted and where economy in original cost is demanded. Some of the common forms of springless unit type leather and synthetic rubber seals are shown in Fig. 6. At *A* is a springless leather seal that is widely used where restricted axial housing space precludes the use of conventional spring-loaded unit type seals and where sealing conditions are less severe than normally encountered. This is a general-purpose seal, used with heavy lubrication, where space or price is a limiting factor. Such seals can be used to retain grease at low speeds, or they may serve as dust seals on automobile and truck axles.

A narrow, unit type, springless synthetic rubber seal, designed to be a press fit in the same housing bore that accommodates narrow cross-section needle bearings is seen at *B*. This type of seal is also suitable for use with plain sleeve type bearings, in gear-boxes, idler pulleys, gears, farm equipment, and a variety of industrial assemblies where grease lubrication is used. The seal at *C* is a similar type, designed primarily for pressure applications. It is used on small shafts in pumps and kindred equipment. Both

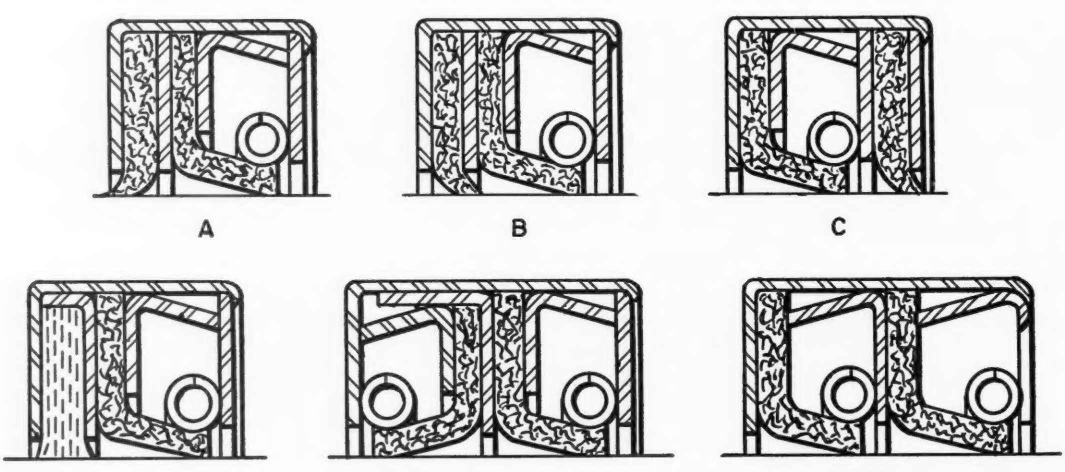
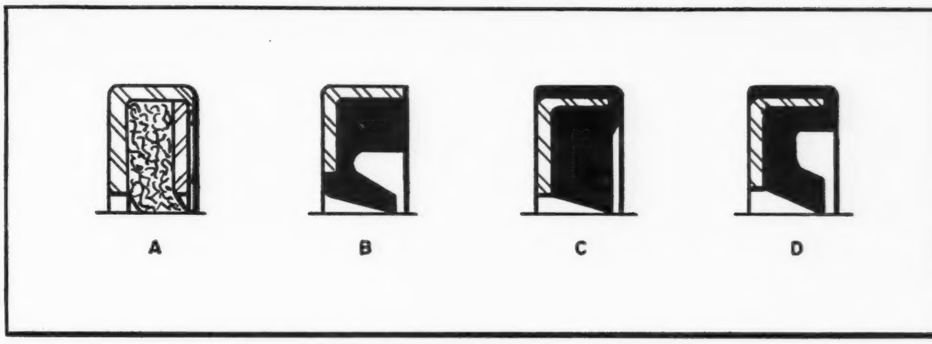


Fig. 5. Unit type seals with double leather sealing members. Similar design seals are available with synthetic rubber members. The design at (E) can be used to separate and retain two fluids or to retain one and exclude the other

Fig. 6. Single springless unit type oil and grease seals of leather or synthetic rubber are economical for certain applications, and can be used where space requirements are a limitation. Positive lubrication is necessary for high-speed operation



seals *C* and *D* have soft synthetic rubber on their periphery. Seal *D* is used for applications where space and price are factors.

Such springless seals, while meeting the demands for inexpensive space-saving requirements, should not be used where there is excessive run-out or whip. General operational limitations are a speed of 1000 feet per minute, and maximum temperatures of 180 degrees F. for seals *A* and *C*, and 250 degrees F. for seals *B* and *D*. Positive lubrication must be available for seals operating in excess of these speeds and temperatures.

Mechanical Seals Retain Gases or Liquids Under High Pressures

Mechanical or rotary seals such as the ones seen in Fig. 7 are extensively used for applications where unit type seals are inadequate. Such devices, which seal axially or along the shaft, are sometimes designated face type seals. In their design, the contact surface of the seal must be in a plane at right angles to the axis. Instead of being cylindrical, as in the case of the unit type leather and synthetic rubber seals previously described, the contact surface must be flat and capable of rotation relative to a similar mating ring on the machine.

Most elementary sealing applications require only that lubricating oil or grease be retained in bearings or simple working parts. In applications of this kind, the unit type leather and synthetic rubber seals have proved adequate. However, in many other instances, gases, oil, or other liquids must be held under high pressures and high speeds. Applications of this kind generally require mechanical or face type seals. Seals of this type are also used where frictional losses must be lower than is required with unit type leather and synthetic rubber seals.

There are two basic designs of mechanical seals. In one the seal is secured to the shaft so that its contact surface rotates against a stationary mating ring in the housing; and in the other the seal is stationary and secured to the housing by a press fit or other suitable means. With the latter construction, the nose of the seal contacts a bearing inner race, or a shoulder or collar on the shaft. Although differing in design, the principles of these two seals are fundamentally the same.

Sectional drawings of some of the simpler forms of mechanical seals in general use today are shown in Fig. 7. The designs at *A* and *B* are mechanical seal structures in which the seal is fastened to the shaft, whereas in the designs shown at *C*, *D*, and *E* the seal is secured to the housing.

Design *A* is a unitary mechanical seal in which the seal assembly is retained within a protective sheet-metal case. In this construction, the complete unit slides over the shaft and into the operating position. The mating surface of the wear ring, or seal nose, and the wear insert are lapped to a smooth finish to provide a leak-proof seal.

The mechanical seal seen at *B* is secured to the shaft by means of a flanged synthetic rubber unit. With this construction, the seal rotates with the shaft, and the wear ring is set in a recess in the seal housing. This seal can be used equally well on either horizontal or vertical shafts.

A case type mechanical seal, which is designed to be pressed into the housing, is shown at *C*. In this construction, the seal wear ring operates against a collar or flange secured to the shaft. This seal is capable of operating at high speeds.

Design *D* is a mechanical seal that can be pressed into an adapter plate. In this case, the seal wear ring abuts against a bearing inner ring or collar secured to the shaft. The seal parts, as is also the case with the design at *C*, are attached to the housing.

A narrow, concentric spring mechanical seal, designed on the principle of a ground joint, is seen at *E*. The lapped sealing surface on the nose operates against the inner race of the bearing, a shoulder on the shaft, or a lapped metal ring on the shaft. This seal is suitable for nonpressure high-speed applications, and is desirable where radial and axial space is restricted. Also, it will compensate for end play, wabble, or misalignment.

Some recent designs of mechanical seals have been so constructed that they require minimum space axially and radially, resulting in low-cost design, construction, and assembly. In addition to the single-acting mechanical seals shown, double seals are often applied, especially where corrosion problems are encountered or where materials containing large percentages of solids are handled.

Mechanical seals have already demonstrated their utility in many industries and on a wide variety of equipment. They have been successfully used in pumps, compressors, speed reducers, washing machines, motor cars, etc. Operation of mechanical seals is limited to a temperature of approximately 300 degrees F. However, special seal materials are available which can be used at operating temperatures up to 400 degrees F. Speed of operation should not exceed 5000 feet per minute. With new designs and new seal materials constantly being developed, it is anticipated that even higher speeds will be permissible.

Because of the importance of trouble-free performance of bearings and other devices used in modern mechanisms, the specification of the right oil or grease seal for the job is something that deserves well informed and considered decisions. While the operating limitations given in this article are rather conservative, they may in some cases be too high and in others too low, depending upon other conditions.

No iron-clad rule can be formulated for making an intelligent seal selection, as it is a combination of conditions at a given time that determines the effectiveness of a seal. In selecting suitable seals for a given job, the designer must have a broad knowledge of the characteristics of the various types of seals available and their operating limitations.

Where unusual operating conditions prevail, special seals of most of the types described and illustrated can be designed for a given application, which will handle conditions that exceed the limitations given. Because of the diverse conditions which exist, and the difficulty of analyzing them, it is best—except in the most simple applications—for the user to consult the manufacturer before applying a seal to a particular job.

* * *

A new edition of the booklet "A Guide for Selling to the U. S. Air Force" has been announced. The booklet explains Air Force buying procedure, and the information presented is designed especially to be useful to executives of small concerns. Copies can be obtained without charge by writing to the Commander General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio, attention MCPAXC-1, Contractors Relations Section; or to the Northeastern Air Procurement District, Air Materiel Command, 14 Court Square, Boston 8, Mass.

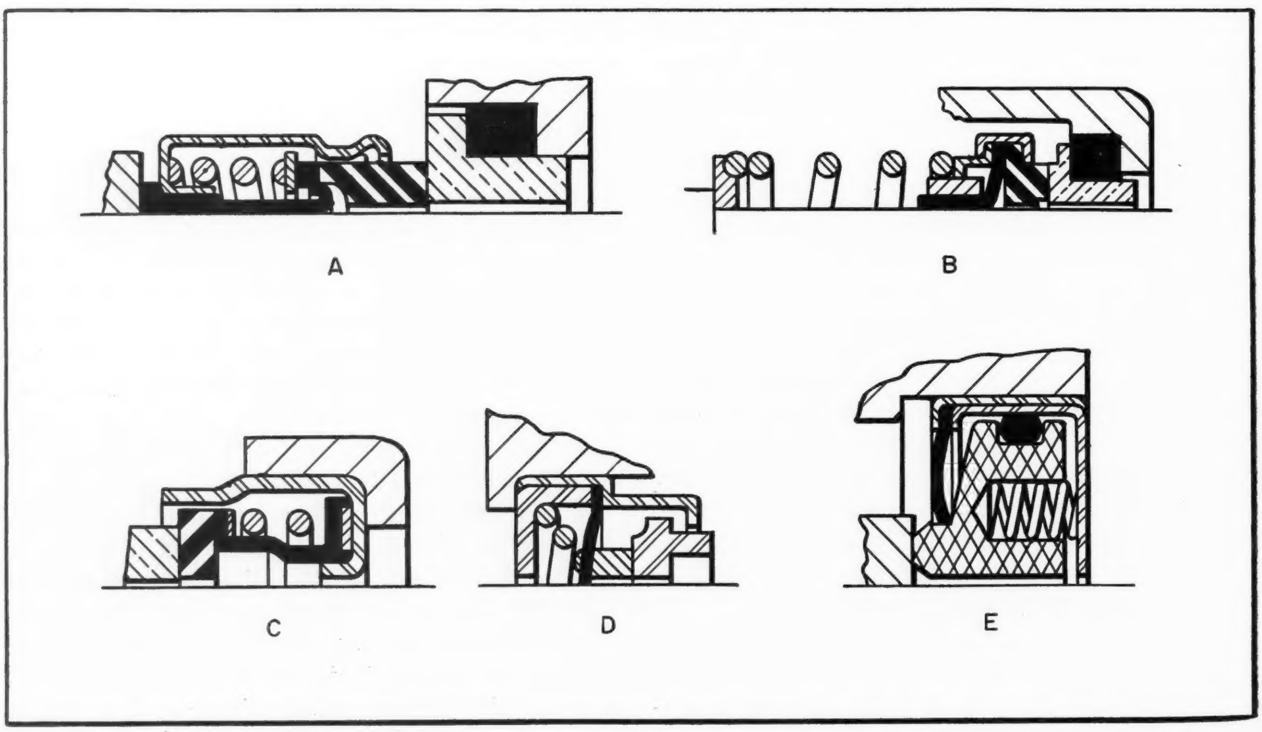
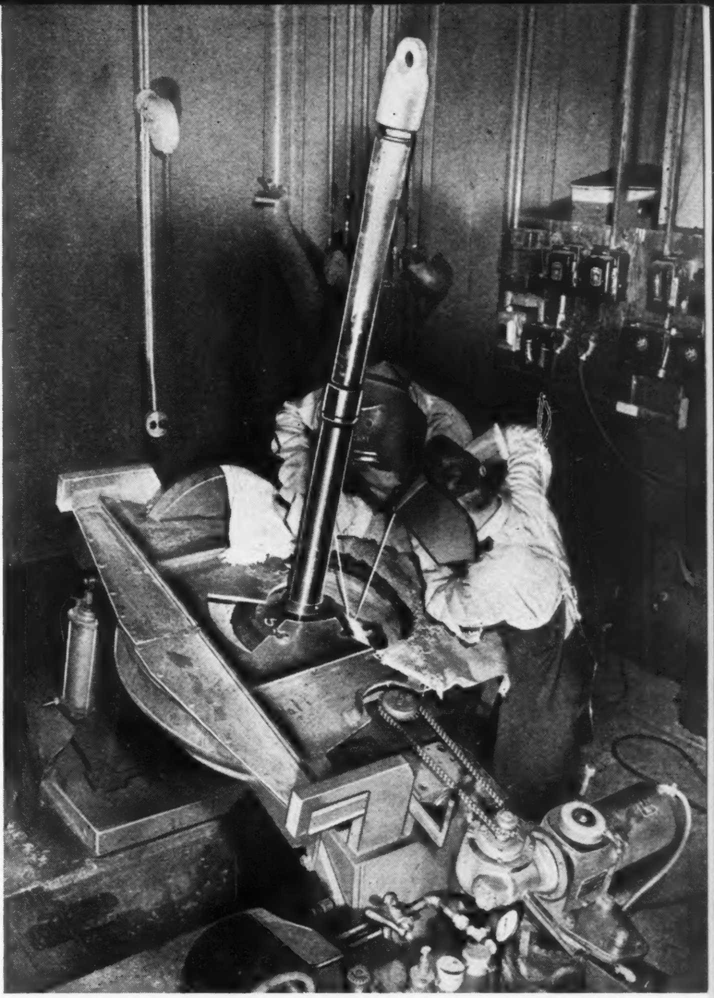


Fig. 7. Mechanical or rotary seals are used where gases or liquids must be held under high pressures at high speed. In the designs shown at (A) and (B), the seal is fastened to the shaft, while in those at (C), (D), and (E) the seal is secured to the housing

Welding Turbine Shafts and Wheels for Jet Engines



Sound Welding Technique is Required in Joining Turbine Wheels and Shafts of Jet Engines to Obtain Strong, Accurate Assemblies. The Methods Employed at Wright Aeronautical Corporation to Meet High Quality Specifications are Described in This Article

By GEORGE H. DeGROAT

ONE of the main components of the General Electric powerful J-47 turbo-jet engine is a single-stage axial-flow gas turbine, made up principally of a forged shaft welded to a wheel that contains the turbine buckets. An extremely high quality weld is required in joining these two members of the turbine, and every step of the welding process must be carried out in strict conformance to exacting specifications. The means employed to meet these specifications at the Wright Aeronautical Corporation, Wood-Ridge, N. J., (which is co-operating in the production of this engine) are described in the following.

In order to understand the requirements, consideration must be given to the material being welded. As the turbine wheel operates at high temperatures, it is made of a high temperature resistant alloy forging containing about 16 per cent chromium, 25 per cent nickel, and 6 per cent molybdenum. The shaft, which operates at a relatively low temperature, is made of a more machinable low alloy steel—AMS 6415, with an analysis of approximately 0.40 per cent carbon, 0.70 per cent manganese, and 1.65 to 2 per cent nickel.

Electric arc welding, using a manual flux-coated

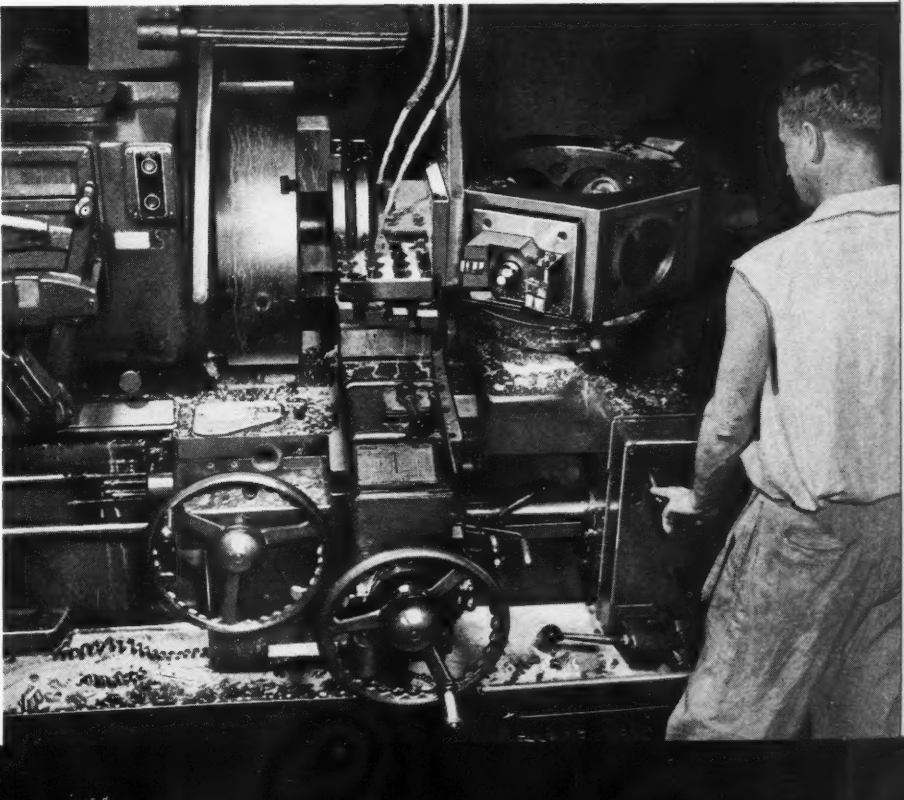


Fig. 1. Preparatory to welding, the bores of turbine wheels and the flanges, or wheel seats, on the shafts are machined to provide grooves for double-vee joints

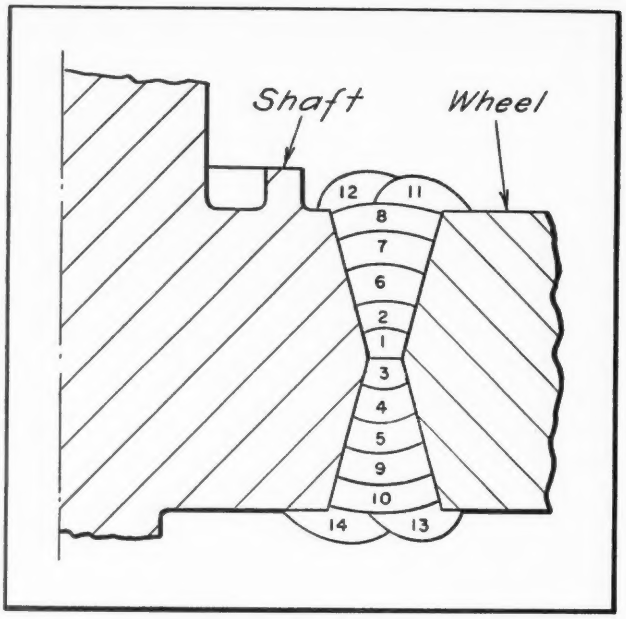


Fig. 2. Cross-sectional diagram of a turbine wheel and shaft joint, showing the multi-bead welding technique used and the sequence in which the beads are applied

electrode, is employed for this work. This method permits careful attention to each phase of the process, insuring soundness of the weld, strength, and good appearance. Also, heat can be applied with accuracy at the point where it is needed for just the length of time required. The welder has close control over the arc, which is quickly and easily directed; moreover, by varying the current, the welding heat can be adjusted to the exact amount necessary for good fusion.

In preparing the wheel and shaft for welding, Warner & Swasey turret lathes (Fig. 1) are employed to machine both faces of the wheel bore and both sides of the flange, or wheel seat, on the shaft in order to provide a butt joint of the double-vee groove type as shown in the cross-sectional view, Fig. 2. The entire face of the wheel, except the locating surfaces, is washed with a pigmented metal coating to prevent the adhesion of weld spatter. This eliminates the need for grinding or chipping these surfaces to remove such spatter from the metal surrounding the joint after welding.

In order to avoid circumferential cracks in the sensitive AMS 6415 shaft material, all welding is accomplished under carefully controlled preheating and post-heating conditions. Parts are maintained at a mean temperature of 600 degrees F., which allows the hardenable shaft material that is directly adjacent to the fusion zone to transform slowly into soft decomposition products. Because of the localized nature of the heat source, it has been found necessary to heat for two hours after the final welding, before transferring to the stress-relief annealing operation described later.

To obtain a shrink fit assembly for welding the shaft and wheel together, the wheel is preheated at 1000 degrees F. for a minimum of two hours, and the shaft is preheated for the same length of time at 450 degrees F. Fig. 3 illustrates the work being loaded into Gehnrich gas-fired furnaces for this operation. After being preheated, the wheel and shaft are located concentrically on positioners (Fig. 4) for aligning during tack-welding. These positioners are provided with gas burners, which maintain a temperature of 600 degrees F. to equalize the temperatures of the wheel and shaft.

The outside diameter of the shaft is machined approximately 0.055 inch larger than the inside

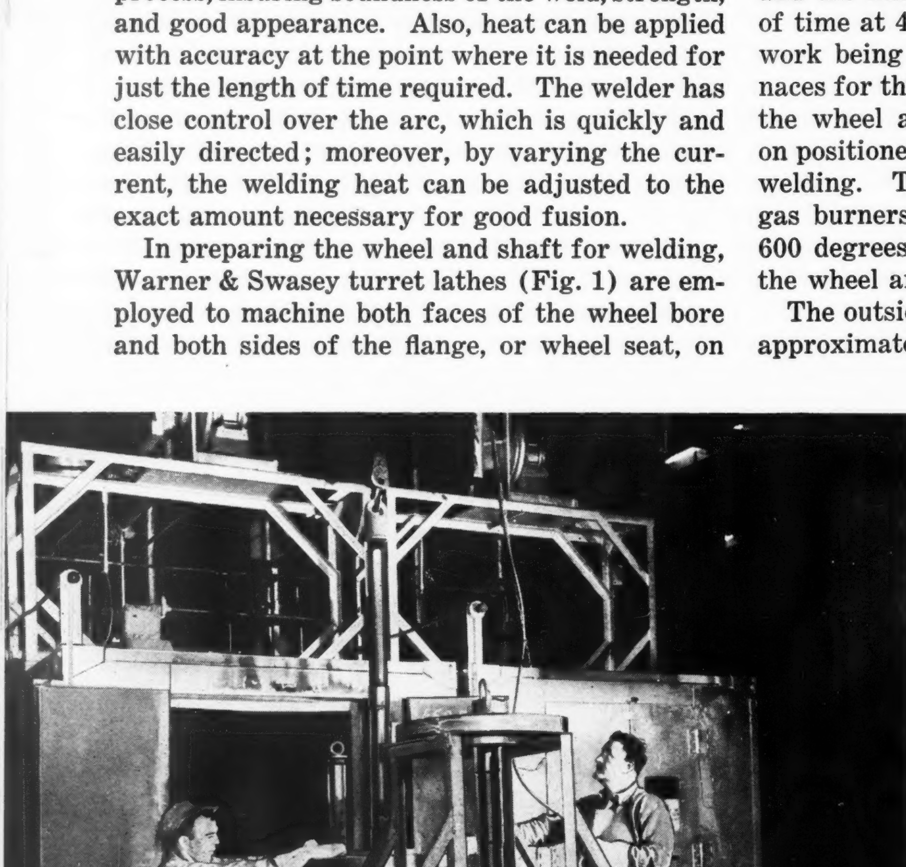


Fig. 3. Turbine wheels and shafts are loaded into gas-fired furnaces for preheating. To obtain a shrink fit in assembly before welding, the wheels are heated to 1000 degrees F. and the shafts to 450 degrees F., after which their temperatures are equalized at 600 degrees F.

diameter of the wheel to effect a tight shrink fit. At the preheating temperature of 600 degrees F. this shrink fit is reduced to approximately 0.035 inch due to the different expansion of the two materials. The compressive forces thus obtained help to avoid shrinkage cracks in the relatively thin tack-welded beads. Additional precautions are taken at this point by having the four tack welds deposited in pairs by two operators working diametrically opposite each other. This prevents dimensional misalignment and produces optimum stress distribution.

Following tack-welding, the work is transferred to the specially designed positioners seen in Fig. 5 for completion of the welding. Here, again, the temperature is maintained at 600 degrees F. during the welding operation by means of gas burners. Valves for changing the air-gas mixture facilitate the adjustment of this temperature when necessary.

Using 400-ampere direct-current welders, with reverse polarity, two operators, working simultaneously, produce the multiple bead pattern shown in Fig. 2. By successively igniting new electrodes in the arc of partially consumed electrodes, the weld is semi-automatically deposited continuously around the circumference of the wheel without stopping. This procedure eliminates cold starts and crater cracks resulting from frequent starting and stopping, and prevents loss of time in cleaning and grinding the ends. Flux is carefully removed from each completed bead before the next bead is laid down on top of it. The operators carefully inspect each bead for under-cuts, remains of flux, porosity, etc., by means of a lighted magnifying glass before making the next pass.

Welding speeds of 1.5 to 4.3 inches per minute are obtained through gear reduction drives that rotate the positioners. A.I.S.I. 312 rods are used in diameters from 1/8 to 1/4 inch. A current of 90 to 110 amperes is employed with 1/8-inch rods; 160 to 185 amperes with 3/16-inch rods; and 240 to 280 amperes with 1/4-inch rods.

The electrodes used are especially adaptable for turbine wheel welding because of their ferritic nature. The added ductility thus secured eliminates the hot-cracking tendencies often encountered with electrodes that produce a straight austenitic weld deposit. The high chromium content of these electrodes allows for the dilution and loss of chromium during arc transfer.

After both sides of the assembly have been welded, taking great care to avoid the inclusion

Fig. 4. Special tack-welding positioners having gas flames that equalize and maintain the temperature of the work at 600 degrees F. are employed for aligning the assembly before the final welding

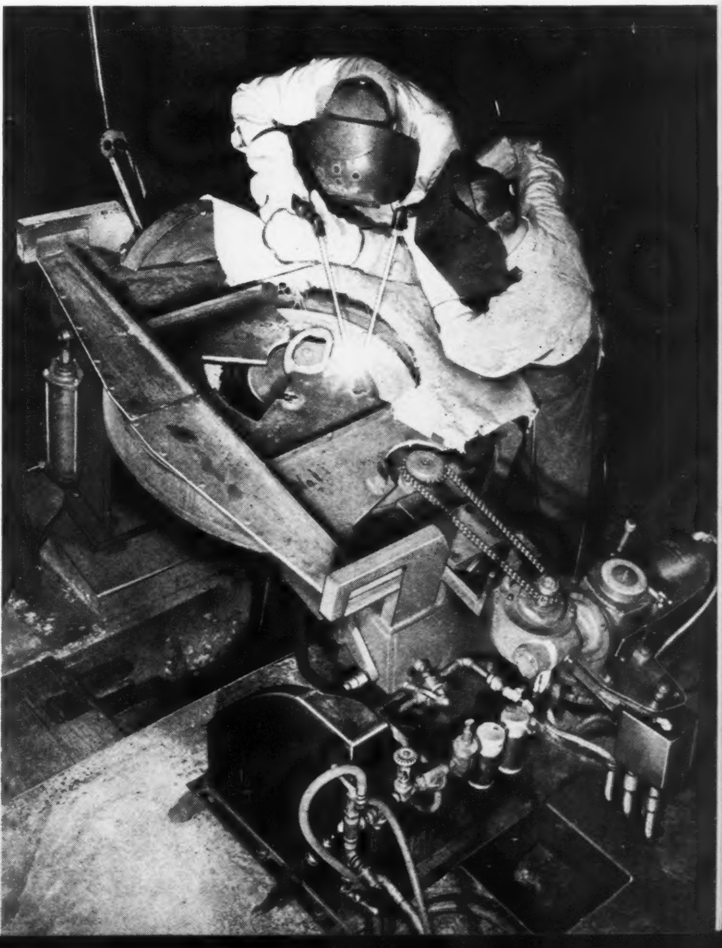


Fig. 5. Welding positioners with air-operated insulated covers and gas flames for maintaining the work temperature at 600 degrees F. are used in the metallic arc-welding of turbine wheels and shafts

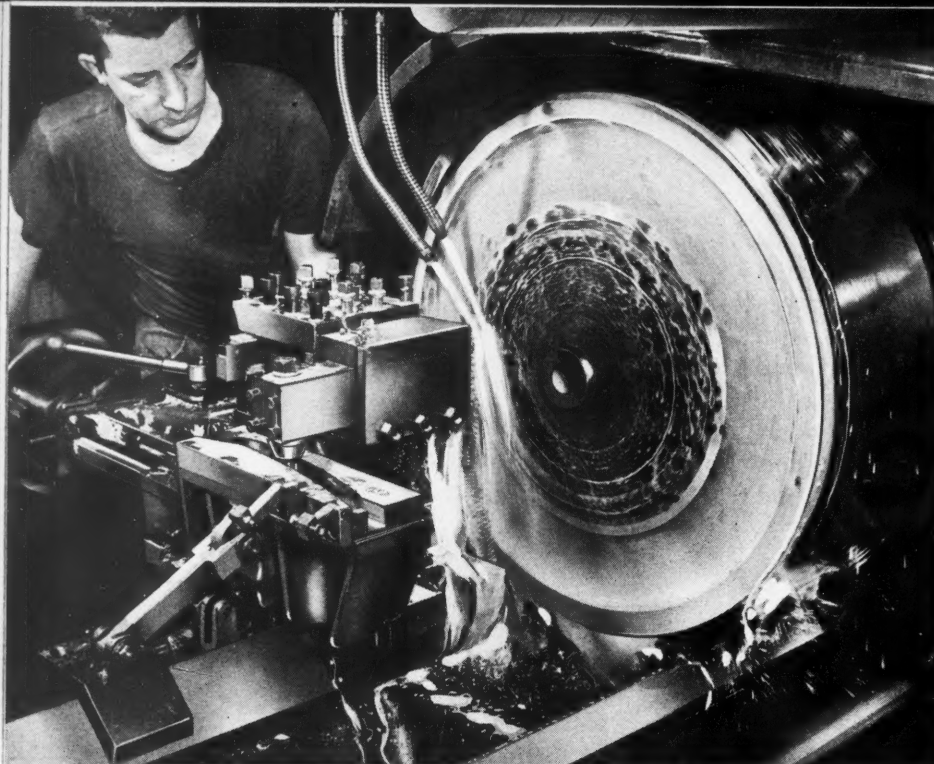


Fig. 6. Carbide tools remove excess beads from welded turbine assembly and finish-machine the faces. A cam attachment on the lathe causes the toolpost to follow the forged contour of the turbine wheel

of flux particles or gas bubbles in the melt, the work is heated at 600 degrees F. in the tack-welding stands for two hours. It then goes to the annealing furnace, where it is soaked at 600 degrees F. until a furnace load is procured. In the annealing cycle, the temperature is raised at the rate of 100 degrees per hour until it reaches 1000 degrees F., and this heat is maintained for six hours. Then the temperature is dropped at the same rate until 400 degrees F. is reached, after which the turbines are allowed to cool in air.

Excess weld beads are removed from the two faces of the assembly at the joint by Warner & Swasey turret lathes, as seen in Fig. 6. A cam attachment on the lathe bed controls the movement of the toolpost, so that the forged contour of the wheel is followed. Carbide tools are used in this operation with a feed of 0.012 inch per revolution, the work rotating at 27 R.P.M. Two cuts are taken; the first removes nearly 1/4 inch of stock, thereby cleaning up the excess weld, and the second removes about 0.040 inch for finishing the surface.

After machining the assembly in this manner, a fluorescent penetration inspection method is applied for detecting crater cracks, hot short cracks, pin-holes, or other small defects that may not be revealed by the radiograph. In this operation, the turbines are soaked in a fluorescent penetrant oil for 1 1/2 hours, after which the excess oil is washed off with a water spray. The work is then dipped into a tank containing a finely divided powder suspension developer,

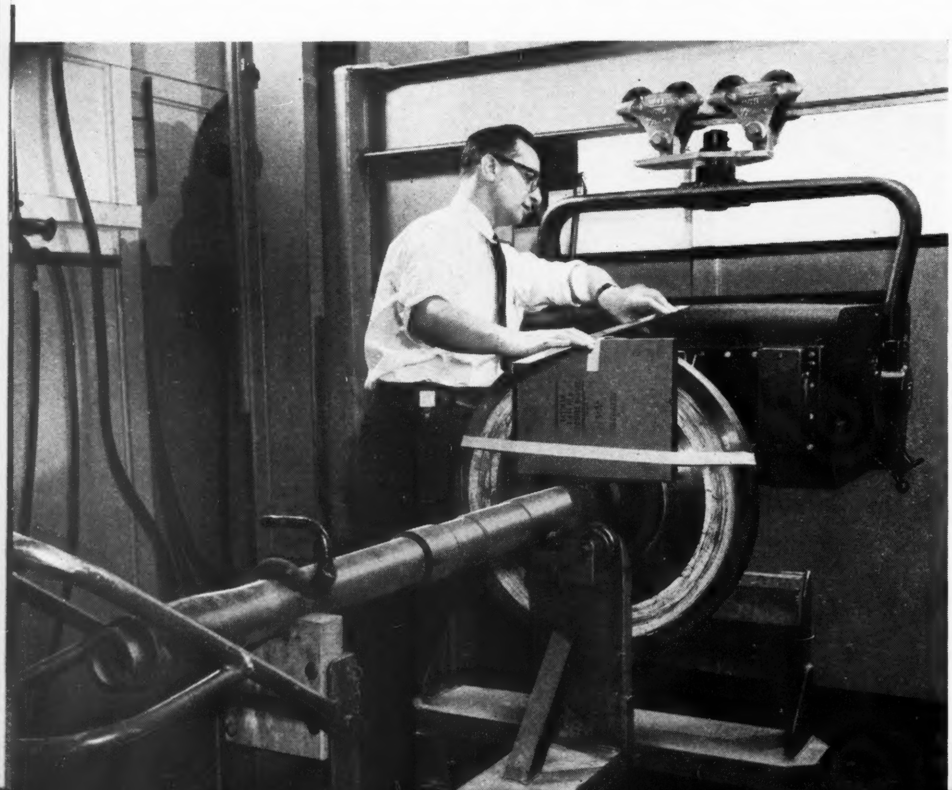


Fig. 7. A 250,000-volt X-ray machine is employed to inspect the entire periphery of the welded joint to insure soundness, proper degree of weld penetration, and uniformity of structure

after which it is dried by hot air. As capillary action of the oil draws the powder to the surface, any cracks that may be present in the weldment are clearly visible under "black light."

A 250,000-volt X-ray machine, Fig. 7, is also used to inspect the welded assembly for degree of weld penetration, soundness, and uniformity of weld structure. For the inspection, the weldment is divided into four quadrants, and the wheel indexed four times, so that radiographic inspection covers the entire periphery of the joint. In addition, the work is examined visually for cracks, under-cuts, and appearance.

* * *

Unique Recessing Tool-Head Operated by Centrifugal Force

Fabrication of tubular heat exchangers involves the drilling and recessing of a large number of holes in the end supporting plates or "tubesheets," as they are commonly called. The recesses, which are of annular form, grip the tubes when they are expanded into the holes in the sheets. A unique tool-head was developed for performing the recessing operation, as shown in Fig. 1, where it is seen set up on a radial drilling machine. When the tool-head has been positioned axially—with the tool bit in the hole—and spindle rotation has started, the bit is automatically fed outward by centrifugal action.

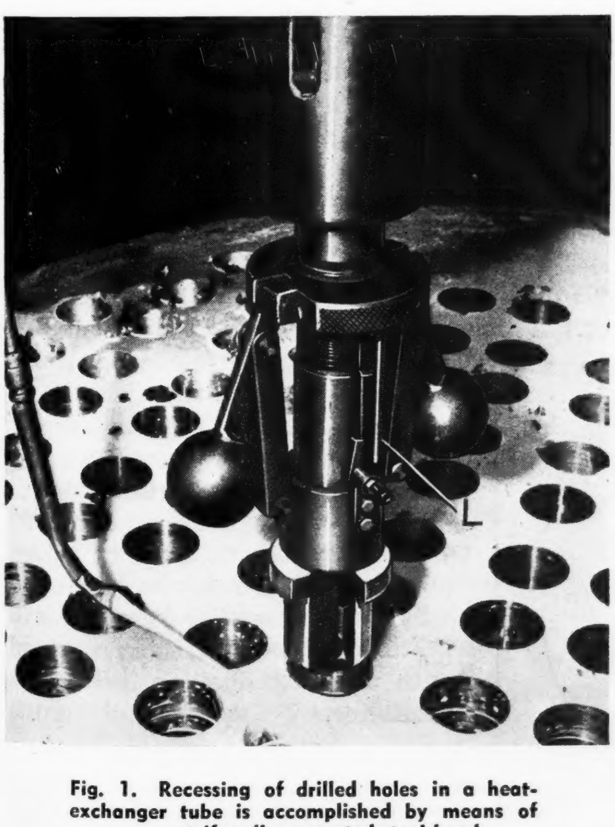


Fig. 1. Recessing of drilled holes in a heat-exchanger tube is accomplished by means of a centrifugally operated tool-head

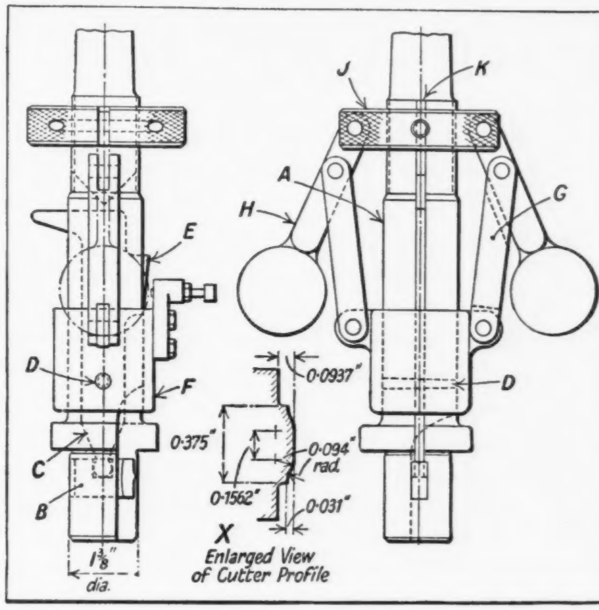


Fig. 2. When the spindle rotates, governor arms (H) move outward, raising sleeve (F) and causing lever (C) to pivot, which forces the recessing tool into the work

As seen in the detail drawing of the tool-head, Fig. 2, the upper end of the casehardened and ground body *A* has a shank that is tapered to suit the machine spindle, and the lower end is formed into a shouldered pilot. The body is slotted to accommodate the transversely sliding, high-speed steel tool bit *B* and an operating lever *C*, which pivots about pin *D*. A tapered cam surface *E* on the lever is engaged by an adjustable screw on sleeve *F* to move the tool bit outward. The sleeve is free to slide up and down on the body, and is attached by two pivoted levers *G* to the governor arms *H*. These arms are pivoted in slots in the knurled, threaded ring *J*, which can be adjusted axially on the body and locked by a set-screw engaging one of two diametrically opposed keyways *K*.

As the spindle is rotated, the governor arms are moved outward by centrifugal force, thus raising sleeve *F* and causing lever *C* to pivot. This action results in moving the recessing tool outward into the work. Upward movement of the sleeve is limited by a stop-rod projecting downward from ring *J*, as seen at *L* in Fig. 1. Fine adjustment for radial depth of cut is obtained by setting the screw in the sleeve. An enlarged view of the tool bit profile is shown at *X*, Fig. 2. The pilot end of the tool-head body is cut away to provide clearance for chips.

* * *

Great Britain exported three times as many passenger cars as the United States in 1950.

Form-Grinding of Carbide Tools

By WILLIAM C. BETZ

AS industry is using more and more carbide, means must be found to grind and shape it. In making carbide tools for turning and milling, special processes are required to produce the various forms needed. The grinding of a male radius on a flat tool, for example, may be done on one of the new carbide tool grinders with a diamond-faced wheel. When the shape and dimensional tolerances do not have to be held closely, the tool may be rotated against the wheel free-hand and the radii checked with a metal contour gage or on a comparator. Fairly accurate work may be done by this method, especially if the radius is of a good size.

There are, however, more accurate methods that can be used. By strapping the tools to the faceplate of an internal grinder, as shown in Fig. 1, both male and female radii can be ground in carbide tools, using small-diameter diamond wheels. In grinding the male radius, a handle is fastened to the faceplate and two stops are clamped to the back of the plate to limit the radius of the arc of travel through which the tool is moved, as shown in the view at the left. Female radii are ground in the conventional manner, as shown at the right.

Another method of grinding radii or other shapes in carbide is as follows: A round piece of high-speed steel, with a bore finished to suit an arbor, is turned to as near the finished shape as possible. The steel piece is hardened to about 65 Rockwell C. The exact form is then ground into this blank by using a grinding wheel of the proper grit, bond, and face width, placed on the wheel mount of a surface grinder.

The wheel is accurately formed to the shape required by using a modern type radius and angle wheel-dresser, of which there are many on the market. The formed wheel, in its mounting, is then transferred to a cylindrical grinder having a spindle that will take this wheel mounting, and the form is ground into the master crusher.

In order to produce the exact shape of the required tool in the diamond wheel, a metal wheel mount must be made. This may be of cast iron or machine steel. A copper ring of sufficient depth to permit machining the tool shape without cutting through is pressed or shrunk on the disc. The shape must be carefully machined in a lathe, so that the hard steel master can be forced into it over its entire face, as shown in Fig. 2. To do this, and to impregnate the copper with diamond dust, the master and the wheel are placed one above the other. The copper-faced wheel is carefully aligned with the contour of the master and is then dropped down on the hard master, revolving the wheel by hand. Then a small pan with rounded corners inside is placed in the base under the master.

Next, the copper disc is given a coat of shellac or heavy oil, and diamond grain of 100 to 200 grit is carefully sprinkled on it as it is slowly rotated by hand. After impregnation, the excess diamond dust and shellac are washed down into the pan with alcohol. The pan is removed and the contents set afire to salvage the dust. If oil has been applied to the wheel, it is washed off with gasoline or naphtha, which is also burned. In cleaning off this excess dust, it is well to use a stiff bristle brush, brushing toward the pan.

For grinding flat tools with a diamond-wheel of this type, surface grinders are employed, but for circular tools, the wheel, with its mounting, must be transferred to a cylindrical grinder. In the case of wide tools, it is necessary to employ a number of shaped wheels, which are used progressively over the tool width. Light cuts must be taken, and the wheels must be lubricated with very thin oils; kerosene will do. The wheels are reimpregnated with diamond dust as it becomes necessary. To grind radii on the

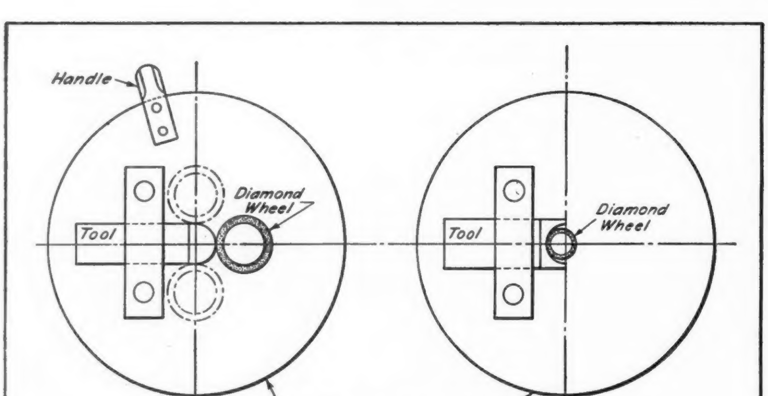


Fig. 1. Male and female radii can be ground in carbide tools by using internal grinders and small diamond wheels

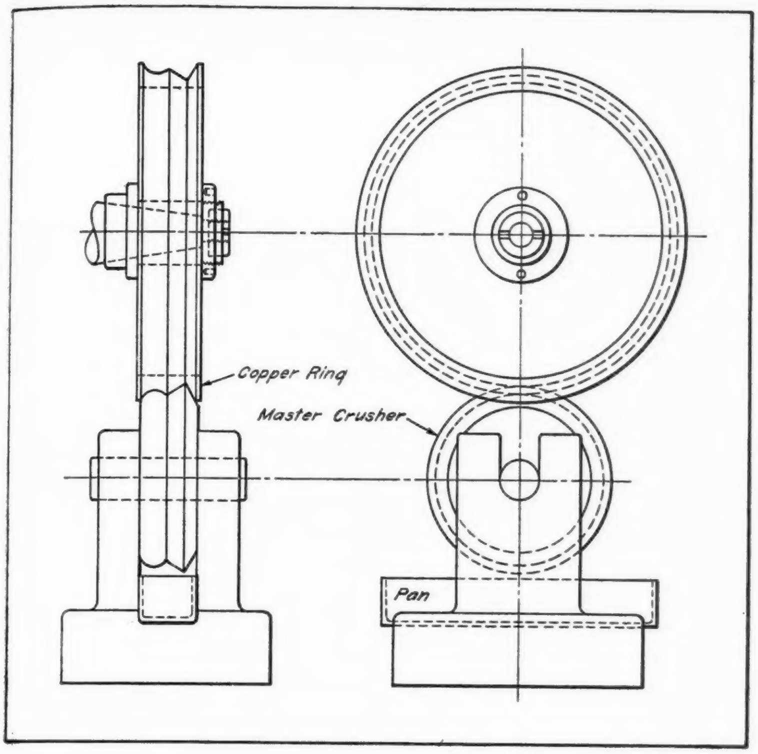


Fig. 2. A master crusher having the exact form of required tool is used to produce a formed wheel made of a diamond-impregnated disc

ends of rods, small diamond-impregnated copper wheels are used on internal grinders. Spherical rod ends are also ground on oscillating head machines, using straight-faced wheels.

In machining a carbide formed-tooth milling cutter, it is necessary to employ an arbor with two sets of centers—one for concentric grinding, and the other for eccentric grinding, as seen in Fig. 3. A nut is used to hold the cutter in place. The cutter blank is first ground on the concentric centers, using a formed silicon-carbide wheel. The wheel will have to be reformed a number of times to rough the cutter to shape. The arbor, with the cutter, is then shifted to the eccentric centers and the individual teeth are roughly backed off, or relieved, with the silicon-carbide wheel, after which they are finish-ground with the diamond-impregnated copper-faced wheel.

To back off the teeth, the pin in the disc face of the eccentric arbor is brought into contact with a tooth face and the nut is tightened to hold the cutter firmly in this position. Through the use of the lever on the arbor shank, the cutter tooth is rocked by hand and the backing off is effected. Stops are placed on the machine to limit the rock of the cutter and prevent over travel and running of the wheel into adjacent teeth. All teeth are ground in this way.

The amount of relief can be varied by adjusting the position of the pin in relation to the eccentric centers. After all the teeth have been ground, the face should be stoned to a 45-degree angle for a few thousandths inch with a fine diamond hone or a fine, hard-bond silicon-carbide stick.

Since there is a great difference in expansion and contraction between the carbide and the base metals when heated, brazing and silver soldering are not satisfactory methods of fastening this material. For some applications, carbide may be soft-soldered on nickel-plated surfaces or attached by the use of some of the new synthetic resins, such as Araldite, etc. As the heat factor for melting is low, the adhesion of carbide to the base metal is good.

For silver-soldered cutting tools, shims of Constantan or Bondwich should be placed between the carbide and the shank to minimize shock in service. Bondwich serves the double purpose of a silver solder and a shock strip. In any case, the carbide should receive a good sandblasting for cleaning purposes, and the shank metal and carbide should be washed in carbon tetrachloride before soldering.

Shot-blasting is not recommended for cleaning carbides for brazing because it does not remove the oxide from the carbides. If possible, carbides should be held by mechanical means, especially for cutting tools.

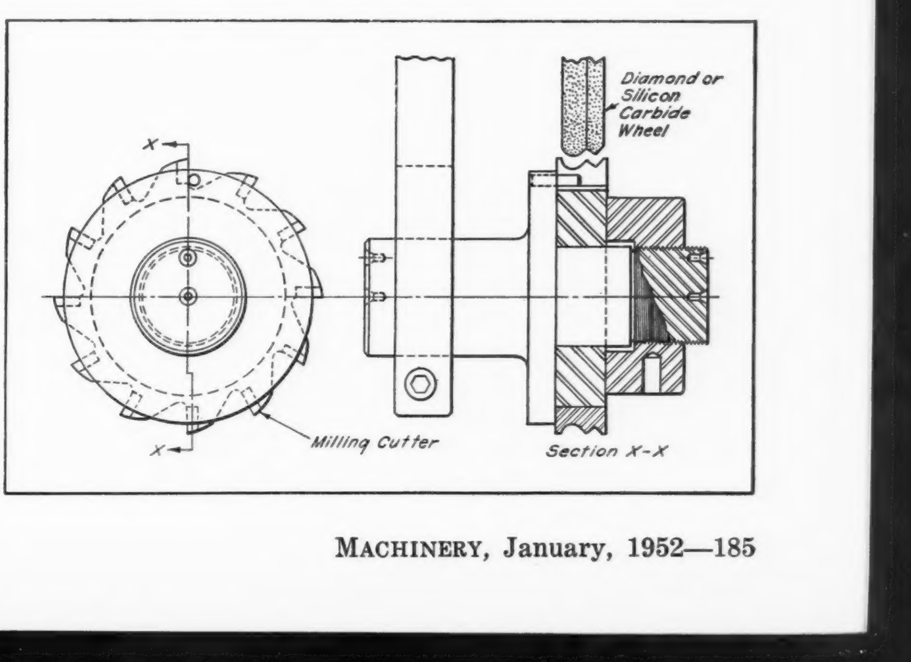


Fig. 3. An arbor with two sets of centers is used for concentric and eccentric grinding of formed carbide-faced milling cutters

Materials OF INDUSTRY

The Properties and New Applications of Materials Used in the Mechanical Industries

Two Inseparably Bonded Metals for Metal and Chemical Industries

The development of two inseparably bonded metals has been announced by Knapp Mills, Inc., 23-15 Borden Ave., Long Island City, N. Y. The first, called "Ferrolum," is a lead-clad steel which has the sulphuric-acid resisting qualities of lead combined with the strength of steel. The second, known as "Cupralum," is a lead-clad copper which exhibits the acid resistance of lead and the electrical conductivity and heat transfer properties of copper.

Lead-clad steel is produced on mobile automatic lead-cladding machines, and lead-clad copper is made by a special drawing process, which creates a chemical bond between the two metals. Containers, tanks, piping, etc., made from lead-clad steel will be useful in handling such materials as sulphuric acid and nuclear products. Lead-clad copper, when used for anodes in the plating industry, is said to permit an increase in current flowing from the anodes through the electrolyte to the work. This material is also available in the form of tubing, which is suitable for use in the cooling of acids.

Compound for Holding Parts while Welding

A plastic cement compound for holding parts together during welding operations is a recent product of the Eutectic Welding Alloys Corporation, 40-40 172nd St., Flushing, N. Y. This cement, designated "Form-A-Jig," is intended to serve as a substitute for a metal jig in cases where small lots are to be welded and there is no time to construct jigs.

In addition to holding parts for welding, brazing, and soldering, the new compound can be employed in tool salvage and similar maintenance for holding broken sections together. It is useful for shielding parts from flames and as a mold for low-melting metals, such as babbitt, solder, lead, and aluminum. This cement will not soil, mar, or corrode the surface of metals on which it is applied, and can be worked with fingers or tools.

Corrosion-Resistant Die-Cast Tubular Rivets

The Gries Reproducer Corporation, 780 E. 133rd St., New York 54, N. Y., has placed on the market a new line of small zinc-alloy tubular and semi-tubular rivets. Being made of zinc alloy, these rivets are rustproof and corrosion-resistant. Sufficient strength for low-stress applications not requiring the use of steel or brass is assured, since the tensile strength is 45,000 pounds per square inch.

The rivets are suitable for both machine and hand applications. They are available in standard sizes including diameters from 1/16 to 9/64 inch and lengths up to 3/8 inch, with oval or flat countersunk heads. Plain, bright, and assorted commercial finishes can be supplied.

Vaporizing Film of Crystals Acts as Corrosion Inhibitor

The use of "Cor-In," a rust preventive developed by the Organic Products Co., Irving, Tex., presents a different approach to the prevention of corrosion. Instead of acting as a coating to exclude air and moisture vapor from the surface of the metal to be protected, it forms an adherent film of crystals that vaporizes and acts as a neutralizing agent, destroying the corrosive effect of all moisture or water vapor that comes in contact with it.

"Cor-In" is applied by brush, spray, or dip. After application, the part is wrapped or covered, so as to prevent, as far as possible, the ingress of moisture vapor and provide protection from the air. It has many uses, including the protection of dies, hand tools, cutting tools, work in process, and parts in shipment and storage. One of its advantages is the fast, economical way

in which a part to which it has been applied can be made ready for use again. This is done by simply removing the wrapping and blowing off the remaining crystals with an air-gun or wiping them off with a cloth.

General-Purpose Machinery Oil with Metal Adhesiveness

A general-purpose machinery oil having the unique feature of metal adhesiveness has been developed by the Magnus Chemical Co., Inc., Garwood, N. J. "Kling-Oil," as it is called, clings tenaciously to the moving parts of machinery, thereby reducing the number of oilings required.

Its use results in less dripping and spattering, and promotes safer and cleaner shop conditions. The adhesive property of the oil is not affected by the rubbing action of moving parts. No "gumming" or "build-up" is said to be experienced after continued use. It has an S A E 30 viscosity, and is applied by the methods ordinarily employed for oils in this class.

Rust Preventive Additive for Petroleum Oil

Petrobase 210—a synthetic rust preventive additive for petroleum oils, petrolatums, and waxes—has been developed by the Pennsylvania Refining Co., Butler, Pa. This compound causes oils and waxes to displace water from metal surfaces and prevents redeposition of aqueous vapors or liquids on the metal surface.

It is applicable mainly in the following classes of oils: Preservative oils and compounds conforming to government specifications; industrial preservative or "slushing" oils; oils used to lubricate small motors, hinges, tools, and other household appliances; and water displacement fluids that selectively wet metal surfaces, causing a thin oily film to be deposited on the surface to prevent rust and provide protection against finger marks.

Drawing Lubricants with Adhesive and Heat-Resistant Qualities

Lubricants designed for use in drawing, forming, stamping, cutting, and piercing operations on stainless steel and other hard metals have been announced by the Forbex Corporation, 125 Broad St., New York 4, N. Y. These lubricants possess adhesive and heat-resistant qualities, which makes it possible to maintain a tough, even, unbroken film around the metal under extreme pressure and heat conditions.

These "Ten Series" lubricants contain no fatty acids or sulphur, are safe for operators' hands, and will not separate out or become rancid. They include wax lubricants, compounds, oils, and pastes with different viscosities, grades, and characteristics for different types of jobs. By their use, gall-free, scratch-free surfaces are obtained and the need for prior surface treatment is eliminated.

Phosphate Compound Provides a Corrosion-Resistant Paint Base

Anchorite 100, a new phosphate compound for treating metallic parts prior to painting, has been brought out by Octagon Process, Inc., 15 Bank St., Staten Island 1, N. Y. The action of this compound makes the surface of steel, iron, zinc, and cadmium parts resistant to corrosion and provides a base for organic coatings.

It is applied either by immersion or spraying, and is adapted to both small and large production needs. The immersion process utilizes a series of five tanks constructed of mild steel. Zinc and cadmium require only from thirty seconds to one minute in a very dilute aqueous solution of Anchorite 100, while some steel alloys occasionally require as much as five minutes.

The spray process is recommended for high-speed treatment of such products as automobiles, washing machines, and bicycles. For this method, a five-step spray chamber machine is used. With such a set-up, parts can be cleaned, phosphated, and painted in succession.

Water Soluble Cutting Fluid for Metal-Working

The commercial availability of a water-soluble metal-working coolant, called emulsifier STH, for use in cutting, grinding, drawing, and stamping, has been announced by General Aniline & Film Corporation, 22 Center Square, Easton, Pa. It is said to posses good lubricating properties, and is recommended for all types of metal-working machines that employ coolant recirculating systems, properly sealed for handling water emulsions.

Successful results have been obtained in drawing and stamping operations by dipping the sheet in diluted STH before working. Experience indicates that this emulsifier can be used with both ferrous and non-ferrous metals and alloys. It has been found effective in cutting very soft or very hard alloy steels, and provides lubrication in highly diluted solutions, while retaining all the cooling effects of plain water.

Announcement of Prize Winners in Ingenious Mechanisms Contest

THE following prizes have been awarded by the judges for the best papers dealing with ingenious mechanisms submitted in the prize contest that was announced in the July number of MACHINERY:

Two Hundred Dollar Prize

"Intermittent Worm-Gear Train"

By H. B. Schell, Brooklyn, N. Y.

One Hundred Dollar Prize

"Variable Reciprocating Motion from Uniform Rotation"

By L. Kasper, Philadelphia, Pa.

Fifty Dollar Prizes

"Converting Oscillating Circular Motion into Variable Reciprocating Movement"

By W. M. Halliday, Birkdale, Southport, England

"An Automatic and Continuous Feed for Form-Grinding Blades"

By B. Spector, Jamaica, N. Y.

Twenty-Five Dollar Prizes

"Mechanism for Adjusting Size of 'Iris' Drawing Dies"

By Ivon C. Toby, Newington, Conn.

"Simple Means of Producing an Oscillating Movement of Approximately Uniform Angular Velocity"

By Paul Grodzinski, London, England

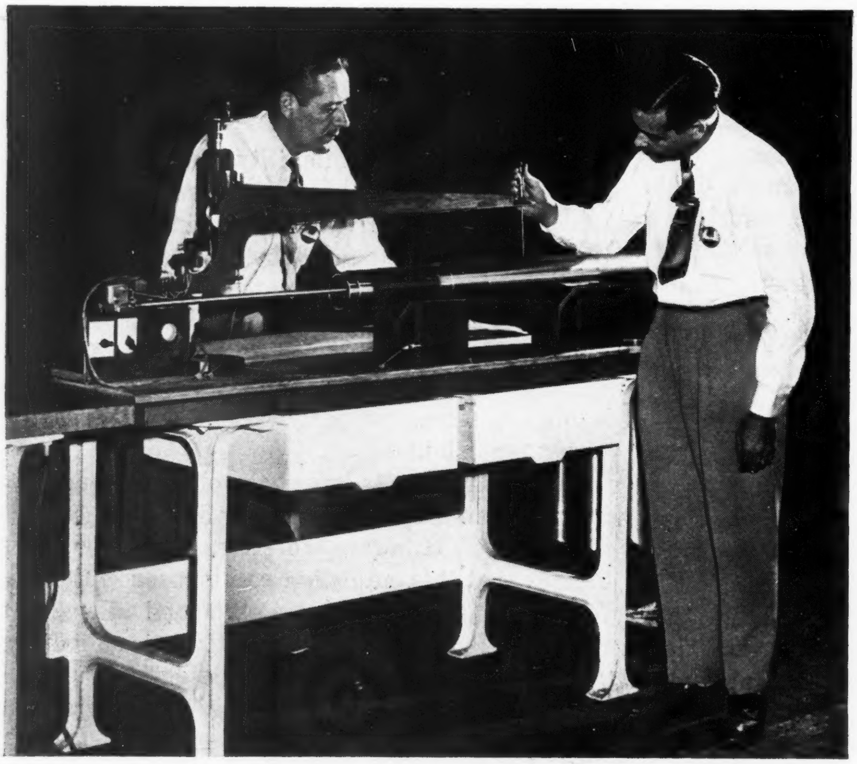
"Mechanism that Produces an Intermittent Rotary Motion"

By L. A. Erickson, Dayton, Ohio

"Oscillating Mechanism Produces Groove of Uniform Depth in a Concave Surface"

By Lewis B. Payzant, Saco, Me.

These prize-winning articles, as well as other accepted contributions to the contest, will be published in the Ingenious Mechanisms Section during the coming months. This section—a regular feature of MACHINERY since June, 1927—is invaluable to machine designers, as it contains articles describing mechanical principles that can be applied in designing automatic machines and other devices differing widely in purpose.



Wall thickness and concentricity of tubes up to 6 feet in length or more are accurately determined by means of this electronic gage developed by the Quality Control Department of Fairchild Aircraft Division. The difference between two readings of a vernier micrometer, through which electrical current passes, gives the actual wall thickness

Alternate Steels to Conserve Critical Alloying Elements

Abstract of a Paper Read before the Fiftieth Annual Meeting of the National Machine Tool Builders' Association at Hot Springs, Va.

By ALEXANDER H. d'ARCAMBAL
Vice-President and General Sales Manager
Pratt & Whitney Division Niles-Bement-Pond Co.
West Hartford, Conn.

THE alloy situation today is more critical than at any time during World War II. We are faced with a critical shortage of nickel, molybdenum, tungsten, cobalt, columbium, and possibly manganese and chromium. It is necessary to import much of the manganese ore used in this country, about 2,000,000 tons having been imported last year. Manganese ore is found in forty countries in varying quantities, but by far the largest deposits are in Russia. There is very little chromium ore in this country, the principal source being Turkey, although some ore is obtained from South Africa, the Philippines, Cuba, and New Caledonia.

The only bright spot today in the alloy picture is vanadium, of which there was a critical shortage during World War II. The greater abundance today is due to the fact that vanadium is a by-product of the Atomic Energy program, being associated with uranium ores, and as far as can be seen there should be no shortage of vanadium.

The critical shortage of alloying elements today is due principally to the following reasons: (1) A greater production of steel today than at any time in the past; (2) increased demand by the Military for alloy steels; and (3) the jet-engine program. It has been estimated that 10,000,000 tons of alloy-steel ingots must be melted yearly to take care of our defense program if it is carried out to completion.

What is the answer to this serious problem regarding the shortage of the important steel alloying elements? The answer, as far as we can see today, is the use of boron-treated steels. Boron steel is produced by adding boron to the ladle, the boron carrying agent being one of many types, such as the complex deoxidizers (of which Grainal is a good example), as well as Ferroboron, Borosil, etc.

There is only about 1/2 of 1 per cent of boron in Grainal No. 79, together with manganese, aluminum, titanium, silicon, zirconium, and iron. When Grainal No. 79 is used, approximately 4 pounds is added to a ton of steel for the medium- and high-carbon steels. In the case of the low-carbon steels, somewhat more than 4 pounds is added to a ton of steel, which is also true of electric steels. For steels running about 0.30 per cent carbon or higher, the amount of boron in the finished product is only about 0.001 per cent. For the lower carbon steels, boron may run from 0.003 to 0.005 per cent.

The question naturally arises as to what effect such a small amount of boron can have on the properties of steel. Boron has only one function, and that is to increase the hardenability of steel by greatly intensifying the degree of hardenability of the alloying elements present, such as manganese, nickel, molybdenum, etc. In other words, those alloying elements that contribute to hardenability must be present in the steel for the boron to be effective, but the percentage of these alloys can be much lower than in steels without boron, so that the use of boron conserves critical alloying elements.

With so little boron in steel, it is, of course, most difficult for metallurgical departments to determine the percentage except by spectroscopic analysis. Many companies using boron steels do not attempt to determine the amount of boron in the steel; they merely use the Jominy hardenability test on all incoming shipments.

It is generally reported that the machining, as well as the welding, qualities of boron steels are as satisfactory as in the case of steels of similar analysis without boron. The physical properties, including impact values, also are comparable to those of steels without boron. Physical tests have been made on boron steels quenched and drawn to a Brinell hardness ranging from 200 to 400, the steel first being fully quenched, with the result that at least 90 per cent martensite was present in the "as quenched" condition.

Boron steels have the following limitations:

1. Too high a percentage of boron in the steel causes hot shortness and brittleness. Considering the fairly large tonnage of boron steels that has been produced by the steel mills in this country during recent years, however, it is felt that little trouble will be experienced from this cause. Prior to 1951, close to 400,000 tons of boron steel were melted, and in 1951 alone, well over 1,000,000 tons of boron steel were produced.

2. The effect of boron as regards hardenability decreases with increased carbon content. In other words, boron has the greatest effect on the low-carbon steels, and this effect decreases as the carbon content is increased up to about 0.90 per cent carbon. At this point, boron has little if any effect on the hardenability of the material. This means that some trouble may be experienced in obtaining the desired case hardness on boron-treated carburizing steels, especially in the larger sections, as the carbon content in the exterior of the case is usually 1 per cent or higher. This can be partly overcome by using the diffusion cycle in gas carburizing, as well as employing a drastic quench with proper fixtures in hardening the case.

In the case of either the old type of fairly highly alloyed carburizing steels or some of the boron-treated carburizing steels, considerable retained austenite is present in the case after quenching. This is especially true when the carbon content of the case is higher than is usually obtained. By giving such parts a cold treatment—that is, bringing them down to between —100 degrees F. and —120 degrees F., the retained austenite is transformed to martensite, with resultant increase in case hardness.

3. Considerable warpage has been experienced in some cases with parts made of boron-treated carburizing steels due to the increased hardness of the core. The core is, of course, low in carbon, and therefore benefits to the maximum from the boron addition as far as hardenability is concerned. It would seem as though some consideration should be given to lowering the carbon content of some of the boron-treated carburizing steels, and at the same time, increasing the chromium content. This should give a greater case hardness and, at the same time, keep the core down to the desired hardness.

4. It has been stated that brittleness has been experienced with certain types of boron steels when they are tempered to 1000 degrees F. or higher after hardening. This may or may not be true, but it has been recommended that when such a high drawing temperature is used, the parts be oil-quenched after being removed from the drawing furnace instead of being air-cooled.

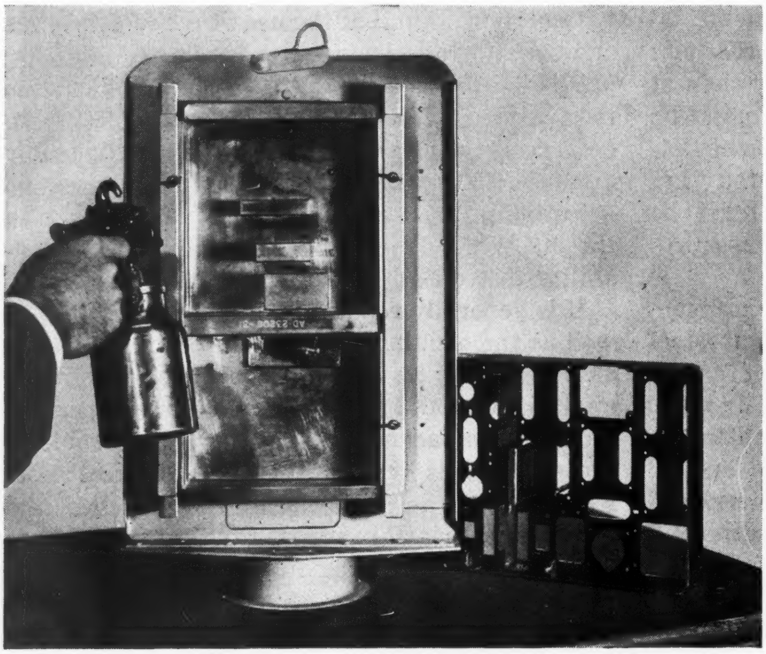
Regardless of these disadvantages of boron steels, companies in the tank, automotive, farm implement, and aircraft industries have been using such steels on a tonnage basis with excellent results. It is highly important that the machine tool industry conduct the necessary experiments at the earliest possible time, so as to be prepared to meet the shortages.

* * *

Stencils Facilitate Code-Marking of Complex Sheet-Metal Assemblies

Code-marking of electronic devices or other sheet-metal assemblies can be speeded up by the use of stencils made by James H. Matthews & Co., Pittsburgh, Pa. In a few seconds, the complete chassis of an electronic device can be coded for its component parts by paint spraying. Each stencil insures sustained accuracy of code marking.

The stencils, which are non-corrosive, are made to fit snugly over the part to be marked, regardless of its shape or size. Each code is precisely relieved on the contour-formed stencil, assuring accurate, legible reproduction. Stencil-holders make it possible to spray both sides of a part in a single operation, and eliminate the necessity of handling a wet stencil.



Spraying paint through a stencil to code-mark the chassis of an electronic device

Floating Tool-Holders of Unusual Design

By W. M. HALLIDAY

WITH certain forms of drilling, boring, reaming, tapping, counterboring, and knurling operations, it is often advisable to mount the cutting tool in such a manner that a specific degree of floating movement is imparted to it during use. A floating movement of the tool will usually permit closer accuracy, better surface finish, and smoother cutting, and minimize the risk of damaging the cutter.

Such floating action should permit the tool to align itself easily with the hole to be machined. This requires sufficient float in all directions. On the other hand, adequate restraint must be imposed to prevent serious misalignment occurring when the tool is first brought into contact with the hole.

In some instances, the tool or tool shank can be attached directly to the machine spindle and arranged to have the requisite degree of float. Generally, however, a special floating holder or chuck is necessary, not only to provide a constant amount of floating action, but also to insure a measure of interchangeability. Frequently, a quick-change type of connection having such floating facilities will be required to permit two or more tools to be successively introduced into the holder.

A simple type of floating holder is illustrated in Fig. 1. The use of a holder of this kind will prove effective in those cases where the tool can be operated in a vertical or a nearly vertical plane. This arrangement, however, will not be so successful if the tool has to operate in a horizontal plane because of the weight of the overhanging portion of the tool. Under these circumstances, the tool will tend to sag below the true axial center of the hole being machined.

Starting such a tool in the hole would, of course, be greatly facilitated by providing a small bevel or chamfer on the leading edges of the blades, so that the tool will automatically be centralized by the longitudinal feeding pressure. In many cases, however, such chamfering is not permissible, and sagging will occur.

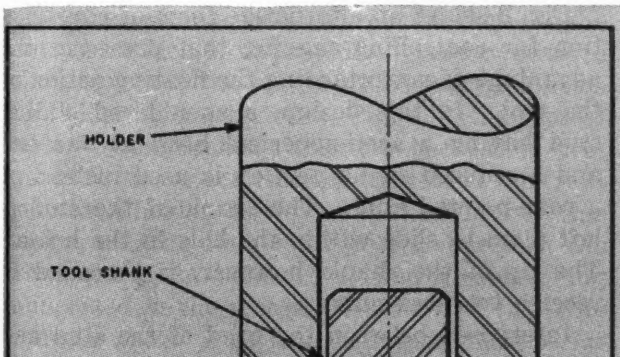


Fig. 1. A common type of floating tool-holder in which the amount of float is controlled by the clearance between the tool shank and holder, and between the driving pin and hole in the tool shank

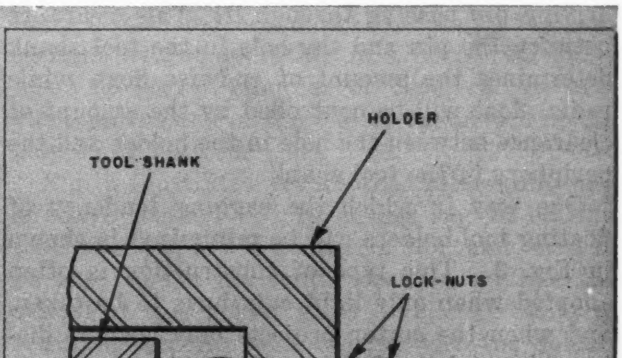


Fig. 2. In this floating tool-holder design, pressure of the compressed rubber sleeve keeps the spherical head of the stud in contact with a center in the tool shank and prevents sagging of the shank

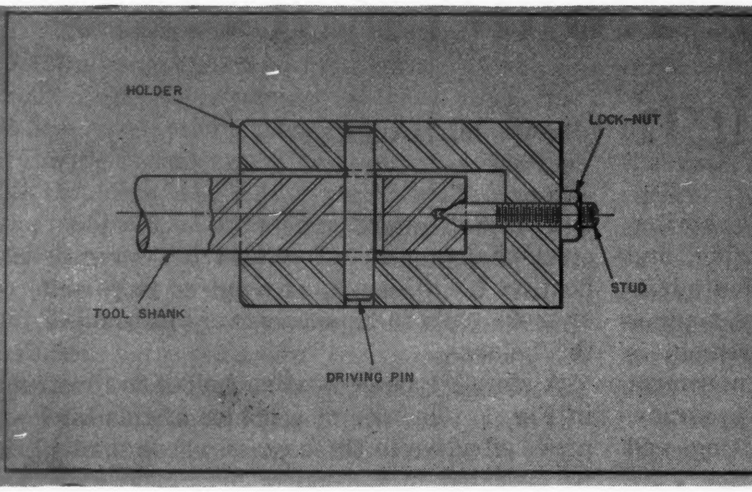


Fig. 3. One method of minimizing sag when the floating tool-holder is employed horizontally is to provide a cone-pointed stud for supporting the end of the tool shank

To overcome these tendencies, the tool has to be centralized manually as it enters the work-piece. Control of sagging should be exercised with all floating holders, especially when the tools operate in the horizontal position.

With the common type of floating holder shown in Fig. 1, the holder can be mounted in the machine spindle or turret. This holder is bored concentrically at one end, the bored hole being larger in diameter than that of the tool shank. A driving pin is pressed into a crosswise hole passing through the wall of the holder. The hole drilled in the tool shank is larger in diameter than the driving pin passing through it. This clearance between the pin and the hole in the tool shank determines the amount of endwise float, while radial float will be controlled by the amount of clearance between the hole in the holder and the periphery of the tool shank.

One way in which the sagging tendency of floating tool-holders can be minimized is shown in Fig. 3. This type of construction is often adopted when only light cuts have to be taken, and when the cutter projects only a short distance beyond the front of the holder.

In this design, a hole in the right-hand end of the holder is threaded to accommodate a cone-pointed stud, the point of which engages a center in the end of the tool shank. A lock-nut serves to retain the stud in any desired position. The stud is adjusted to limit the up and down floating action when the holder is mounted horizontally and the shank is pushed to the right to simulate the cutting position. Maximum centralizing action with this type of holder will be concentrated at the extreme end of the shank farthest from the cutting point. Also, the floating movement will be reduced somewhat by the stud.

Fig. 2 shows an alternative form of construction for controlling sagging that possesses the advantage of not retarding the floating action of the tool. In this design, a shouldered sliding stud having a semi-spherical head at one end and a reduced shank portion is used instead of a cone-pointed stud. The shank of the stud is left plain to slide within the hole in the holder. The tip of the shank, however, is threaded to receive two lock-nuts.

Interposed between the head of the stud and the holder is a hard rubber sleeve. If preferred,

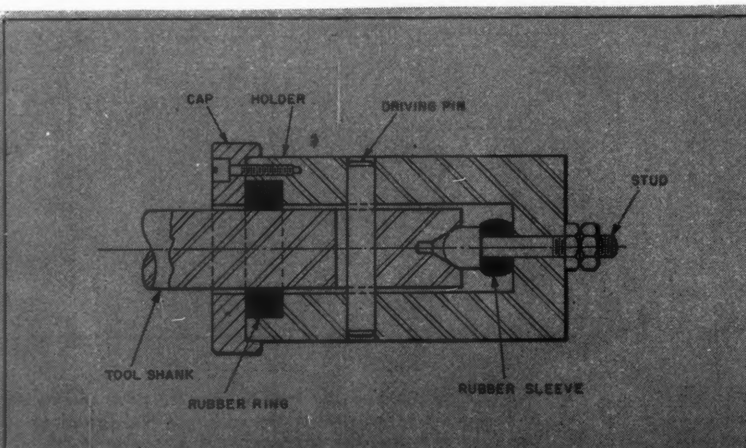


Fig. 4. A rubber ring provided at the front end of the holder minimizes sag of the shank when the tool is removed from the hole being machined

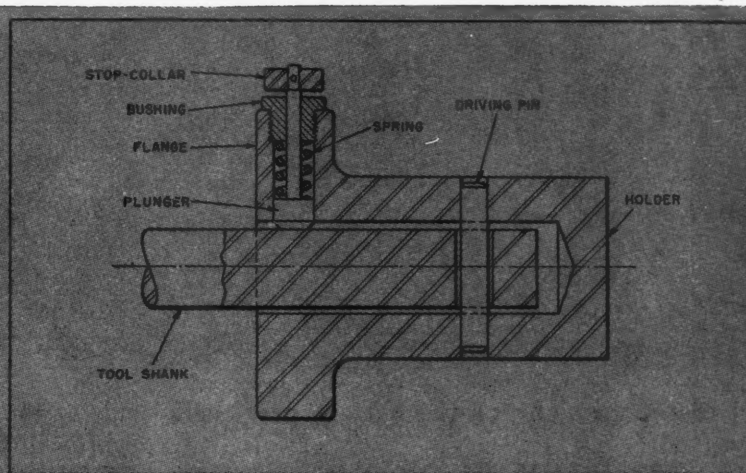


Fig. 5. Heavier tools can be held central without sacrificing any of the floating action by providing three spring-loaded plungers in the holder

the rubber sleeve may be replaced by a light compression spring. Before the tool is brought into contact with a work-piece, the pressure exerted by the compressed rubber sleeve or spring will hold the tool shank in its extreme left-hand position. When cutting commences, the tool will be pushed backward within the bore in the holder, thus further compressing the rubber sleeve. This pressure will be transmitted to the stud, which will press against the shank and hold it central with the bore. This type of holder will be found satisfactory for light cuts with tools of short length and light weight.

Another simple yet useful construction, the object of which is to provide a greater measure of control over the sagging tendency of a floating holder, is illustrated in Fig. 4. This type of holder is particularly effective because it provides means for centralizing the tool at the front end of the holder, as well as at the rear. In this design, a large-diameter recess is bored in the front end of the holder body and a rubber ring is inserted in the recess. The bore of this ring is made about 1/16 inch less than the outside diameter of the tool shank. The rubber ring is held in the correct position by a cap, secured to the end of the holder by means of three cap-screws. When the cap is bolted tightly to the holder, the rubber ring will be compressed to grip closely on the tool shank. The cap is bored to provide clearance for the floating shank. A centralizing stud with rubber sleeve is employed at the opposite end.

The rubber ring will counteract the weight of the tool shank overhanging the holder, thereby preventing any undue amount of sag when the tool is extracted from the hole in the work-piece. This simple construction will be found exceedingly useful and economical for small reamers of light weight operating in a horizontal plane when no lead-in chamfer or bevel can be provided on the end of the tool or the mouth of the hole being reamed.

Fig. 5 illustrates yet another interesting and effective method of preventing sag in cutting tools that require a floating action and have to be used in the horizontal position. While the design of this holder gives excellent results in retaining heavier tools central with the holder, its construction is somewhat more complicated

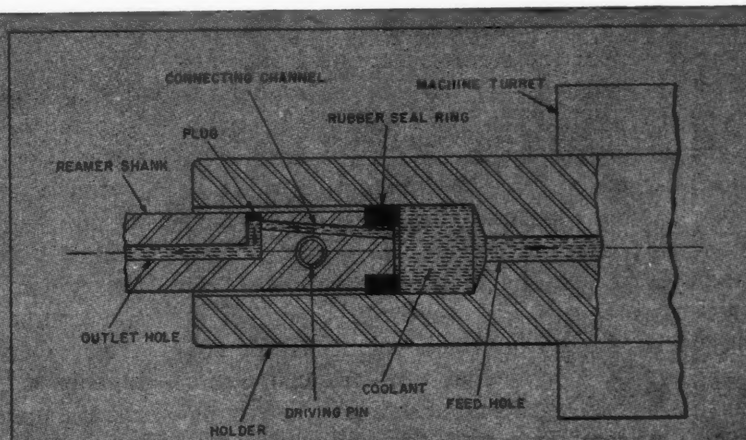


Fig. 6. Coolant can be supplied through shank of a hollow reamer without interfering with the floating action of the holder by mounting a rubber seal ring on the shank

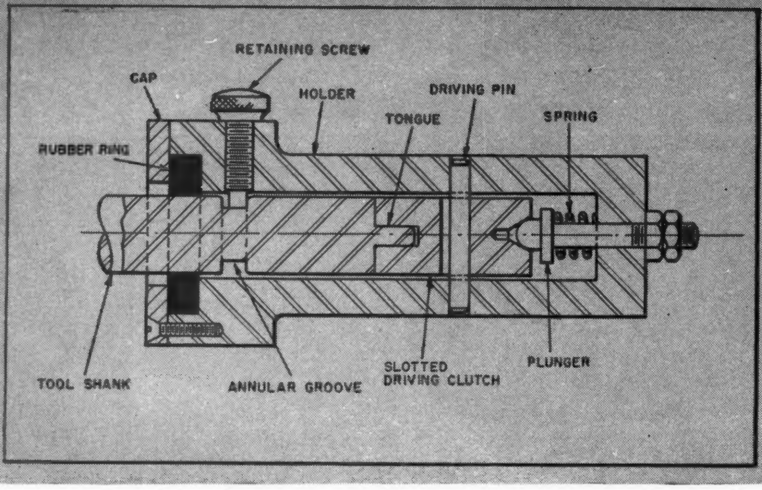


Fig. 7. A slotted driving clutch enables tools to be quickly changed in this holder. The shank and clutch are held in mesh by a retaining screw

and costly than any of the holders previously described.

In this floating holder, the front end of the body has an enlarged diameter flange. This flange is drilled radially at three points, equidistantly spaced around its circumference, for three spring-loaded radial plungers, only one of which can be seen in the sectional drawing. The head portions of the plungers are made a sliding fit within the radial holes in the flange. A threaded bushing, screwed tightly into the outer end of each hole, is bored to provide a sliding fit for the cylindrical shank of the plunger. Pinned to the outer end of each plunger is a stop-collar, and a light compression spring is provided between the head of the plunger and its stationary bushing. The inner tip of the plunger heads is normally in contact with the tool shank, and is chamfered to allow the shank to be readily inserted in the holder.

Since the pressure exerted by the three equally spaced plungers will be the same, the shank will be held central with the bore of the holder, even though a considerable length of the shank overhangs the front of the holder. The floating action of the tool shank in this type of holder will in no way be impaired. This tool-holder can be adapted to tools of various sizes and weights merely by employing springs of the required strength.

The method of compensating for sag provided by this design will be found much more satisfactory than the common method of using two or three supporting screws threaded into the wall of the holder, which have to be arranged to bear lightly against the tool shank if that member should sag too much. With the latter construction, some of the floating action must be sacrificed, since the three supporting screws have to be fixed to the holder body.

In cases where the body of the holder can always be mounted and keyed in the machine turret in the same radial position, it will be possible to employ a somewhat simpler construction than that shown. Instead of using three spring-loaded plungers, two will be found sufficient, provided they can always be located on the under side of the shank. Use of three plungers, however, will often be found time-saving.

In reaming operations, a supply of coolant frequently has to be delivered to the tool throughout the operation. When that is the case, a hollow reamer, fed from the coolant supply normally delivered by the pump, is usually employed. This may cause difficulty, however, if the hollow reamer has to be used in conjunction with a floating holder. The design shown in Fig. 6 illustrates how coolant can be transmitted through a floating holder in a safe and simple manner.

The chief points to be looked out for in this design are to prevent leakage of coolant between the tool shank and the holder, and to avoid having to use a separate rubber tube for feeding coolant to the reamer. In the holder shown, a coolant feed hole is machined through the right-hand end of the holder, which normally fits into the machine turret. This hole is positioned so as to coincide as nearly as possible with the supply pipe, mounted in the center well of the machine turret.

The outlet hole for the coolant is formed along the center of the reamer shank, and a smaller diameter connecting hole is machined from the right-hand end of the shank to a short vertical hole as shown. The mouth of the vertical hole is afterward plugged to make a watertight joint.

The right-hand end of the tool shank is provided with a tapered seat for a rubber sealing ring. In its free state, the outside diameter of the seal ring should be about 1/8 inch greater than the bore of the holder, so that the part will be compressed when the shank is inserted in the bore. Compression of the rubber ring will not seriously impede the normal floating movements of the reamer shank. If desired, a leather cup-shaped sealing ring may be employed instead of the rubber ring, and with certain kinds of cutting compounds, increased life will be obtained.

For some machining operations, it is advantageous to employ a floating holder having quick-change mounting means. Fig. 7 shows one very satisfactory way of achieving this. In this holder, a slotted driving clutch, of the same out-

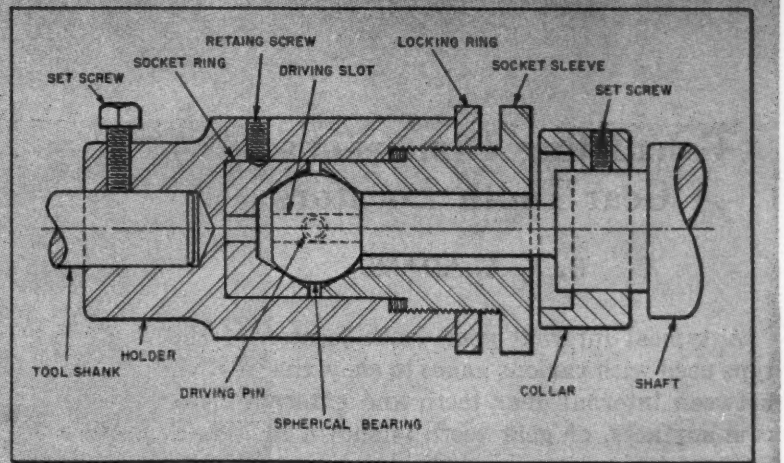


Fig. 8. Ball and socket type of floating tool-holder that permits adjusting the amount of float and provides compensation for wear or slackness

side diameter as the tool shank, is mounted in the holder bore by means of a driving pin, pressed into the body. The pin clearance hole in the clutch is made sufficiently large to obtain the desired amount of axial float. A center is provided in the right-hand end of the clutch to engage the head of a spring-loaded plunger.

The left-hand end of the clutch is slotted to accommodate a tongue which is an integral part of the tool shank. Sufficient side clearance should be afforded between tongue and slot to allow the shank to be readily inserted or removed. The left-hand flanged end of the holder is recessed to form a housing for a rubber ring. This ring serves to support the tool when it is withdrawn from the work, as in the case of the holder shown in Fig. 4. The ring is held in its housing by a cap secured to the holder by three screws.

A radial hole is drilled and tapped in the flange of the holder for a knurled-head retaining screw. The lower end of this screw fits into an annular groove machined around the tool shank. This groove must be wider than the screw tip by an amount equal to the end float required.

To remove the tool, it is only necessary to withdraw the screw slightly, after which the tool may be extracted by a sharp pull, which overcomes the gripping pressure imposed by the compressed rubber ring. This type of quick-change, floating tool-holder works equally well in either the vertical or the horizontal position, and will be found satisfactory for large-diameter tools, which might cause trouble by sagging.

Fig. 8 illustrates a satisfactory form of ball and socket type of floating tool-holder, which permits modifying the amount of floating movement, and provides adjustment to compensate for wear or undue slackness. This holder can be used in either a vertical or a horizontal plane, and will handle both large and small tools. In this design, the tool shank is held in one end of the holder by means of a set-screw. Pressed into a bored hole in the opposite end of the body is a socket ring. A retaining screw in the wall of the body holds the socket ring securely in place. The socket ring is provided with a conical recess.

An enlarged bore in the right-hand end of the body is internally threaded for a socket sleeve. A fine-pitch thread should be employed for this joint. The circular head on the right-hand end of the sleeve is knurled. Threaded to the sleeve between its head and the end of the body is a locking ring that is also externally knurled. A conical seat is also machined in the left-hand end of the sleeve, which is identical in respect to depth, side angle, and diameter with the seat in the socket ring.

When mounted in the manner shown, these two conical seats embrace a spherical bearing that forms an integral part of a steel shaft. The right-hand end of this shaft fits the socket hole in the machine turret. Sufficient clearance must be allowed between the reduced diameter section of the shaft and the bore of the socket sleeve to permit a floating movement of the holder body and tool shank relative to the shaft.

A slot machined across one side of the spherical bearing engages a driving pin screwed into the holder body. The driving slot is made considerably wider than the diameter of the pin to permit the necessary floating movements. A dished type collar is fastened to a shoulder on the shaft by means of a set-screw.

By carefully adjusting the socket sleeve within the holder body, the fit between the conical seats and the spherical bearing can be closely controlled. To regulate the amount of floating movement, the collar has to be adjusted on the shoulder of the main shaft so that its left-hand face will contact the end of the socket sleeve at the moment when sufficient floating movement has been imparted to the latter.

Tools can be readily interchanged in this floating holder, provided their shank portions fit the bore in the body or suitable bushings are available. Should wear or slackness occur between the bearing and the conical seats, correction can be made immediately by screwing the sleeve farther into the bore of holder. Thick grease should be put into the space around the conical seats and the bearing, the socket ring being bored out for that purpose.

Calculating Dimensions of Gear Tooth Locators

By F. A. ADAMS

A typical internal gear tooth locator of the type used with various gages to show the relation between internal gear teeth and external slots, cam surfaces, or gear teeth is shown in Fig. 1. Such a device, in which the locating tooth fits into a tooth space of the internal gear, can also be applied to drill jigs, notching dies, and other tools in cases where internal gear tooth location is necessary to perform a specific machining or checking operation.

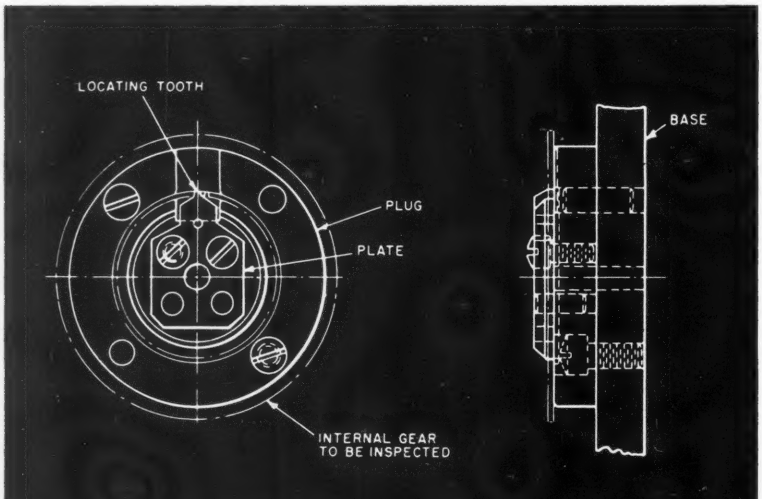


Fig. 1. (Left) Internal gear tooth locator used on gages, jigs, fixtures, or dies where tooth location is necessary for machining or checking operations

The locator consists of a hardened and ground tool-steel plug, which is doweled and screwed to the base of the gage, jig, or die. The internal gear to be inspected or machined fits over the chamfered hub of this plug, the hub being ground to a diameter 0.0003 inch less than the low limit of the inside diameter formed by the gear teeth. Fitting into a counterbored hole and milled slot in the plug, and fastened to it, is a plate on which the locating tooth is machined. The locating end of the tooth is the only part of the plate that is hardened and ground.

In designing the plate, an enlarged view of the locating tooth is drawn, as shown in Fig. 2. To facilitate calculation of the locating tooth dimensions for internal gears having involute teeth, the following formulas can be employed:

$$R = \frac{P \times \sin A}{2}$$

where

P = pitch radius of internal gear; and

A = pressure angle of internal gear.

$$B = P \times \cos A$$

$$C = \frac{90}{N}$$

where

N = number of teeth in internal gear.

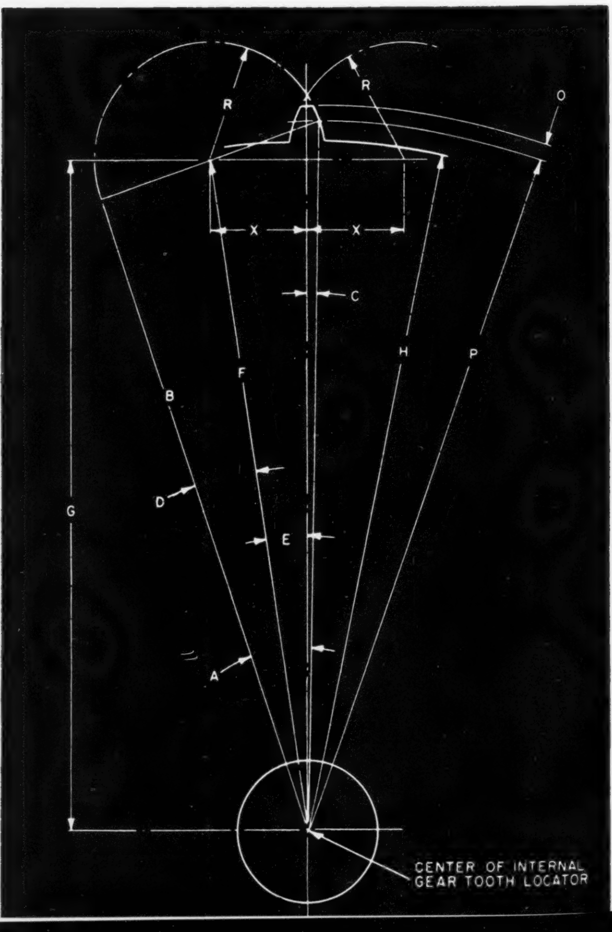
$$\operatorname{Tan} D = \frac{R}{B}$$

$$E = A - (C + D)$$

$$F = \frac{B}{\cos D}$$

$$= B \times \sec D$$

Fig. 2. (Below) An enlarged view of the locating tooth employed on the internal gear tooth locator shown in Fig. 1. Formulas for calculating dimensions are given in the article



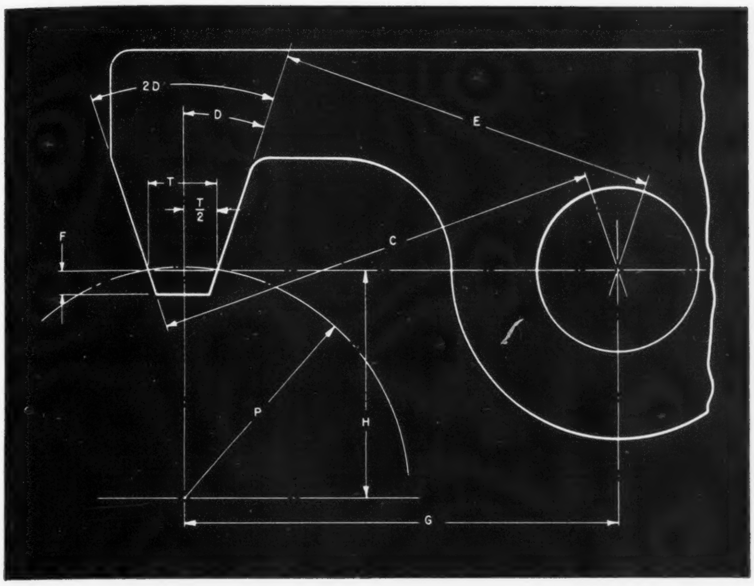


Fig. 3. Pawl locator of the type employed to position a part or assembly with relation to a tooth space in an external gear

$$X = F \times \sin E$$

$$G = F \times \cos E$$

$$H = \frac{J - 0.0003}{2}$$

where

J = low limit of inside diameter formed by gear teeth.

The dimension O on the locating tooth is equal to the addendum of the teeth on the internal gear.

Pawl type locators are often employed on jigs, fixtures, gages, or other tools where a part or assembly must be positioned with relation to a tooth space on an external gear. An enlarged, dimensioned view of such a locating pawl is seen in Fig. 3. Formulas and methods employed to obtain these dimensions are given in the following:

Dimension G will vary with the size of the part or assembly to be inspected or machined, and is obtained from the tool construction drawing.

Dimension T equals the thickness of the tooth on the pitch line of the gear, and can be obtained from a handbook.

$$D = A + \frac{90}{N}$$

where

A = pressure angle; and

N = number of teeth in gear.

$$F = \frac{O}{2}$$

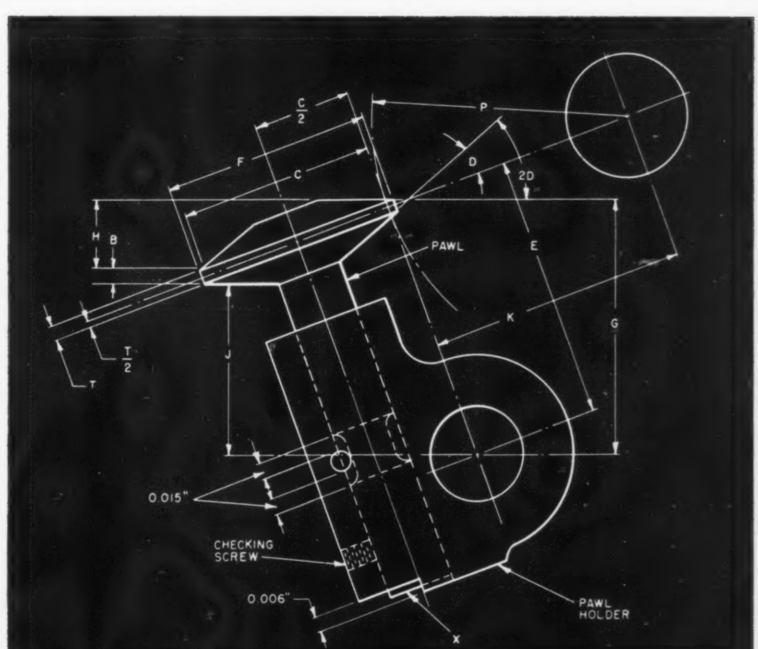


Fig. 4. Flush-pin type of pawl locator. With the gear located radially and the pawl inserted in a tooth space, surface (X) on the pawl must lie within the step on the pawl-holder

where

O = addendum of teeth in gear.

$$C = \left(G + \frac{T}{2} \right) \cos D$$

$$E = \left(G - \frac{2}{T} \right) \cos D$$

$$H = \sqrt{P^2 - \frac{T^2}{4}}$$

where

P = pitch radius of gear to be located.

Another pawl type locator sometimes used for gaging purposes is shown in Fig. 4. With this flush-pin type inspection device, the external gear or gear segment is located radially, and then the pawl is inserted in a tooth space of the gear being checked. The opposite end of the pawl—surface X—must lie within the 0.006-inch step formed by the faces on the lower end of the pawl-holder for the work-piece to be acceptable.

Dimensions C and E will vary with the size of the gear to be inspected, and can be obtained from the gage lay-out or construction drawing. Dimension T equals the thickness of the tooth on the pitch line of the gear, and can be obtained from a handbook. P is the pitch radius of the gear. The other dimensions indicated on the drawing can be calculated from the following formulas:

$$F = C + O$$

where

O = addendum of teeth in gear.

$$D = A + \frac{90}{N}$$

where

A = pressure angle of gear; and
N = number of teeth in gear.

$$G = \left(E + \frac{T}{2} \right) \cos D$$

$$H = C \times \sin D$$

$$B = T \times \cos D$$

$$J = G - (H + B)$$

$$K = \sqrt{P^2 - \frac{T^2}{4}}$$

* * *

More than 38,000 steel bolts, nuts, screws, and rivets of high tensile strength are used in holding together the frame members of a Diesel freight locomotive.

New American Standards for Pipe Fittings

Three new standards recently approved by the American Standards Association are as follows: American Standard Non-Metallic Gaskets for Pipe Flanges, B16.21-1951; American Standard Wrought Copper and Bronze Solder-Joint Fittings, B16.22-1951; and the American Standard Malleable-Iron Screwed Fittings (150-pound), B16.3-1951.

Now, for the first time, non-metallic gaskets can be manufactured and purchased according to American Standard sizes. The wrought copper and bronze solder-joint fittings covered in the standard are used throughout industry for low-pressure and low-temperature water pipes. This standard applies to fittings made of wrought copper or wrought copper alloy material having not less than 83 per cent copper content.

The new standard for malleable-iron screwed fittings is a revision of the 1939 edition. It includes inspection tolerances on fitting dimensions, an amplified section on threading, and additional sizes of elbows, crosses, tees, couplings, caps, and return bends.

* * *

Resistance Welding Paper Contest

A contest in which prizes will be given for outstanding papers dealing with resistance welding subjects has been announced by the Resistance Welders Manufacturers Association. Prizes totaling \$2250 are to be awarded as follows: For those in industry or engaged in research laboratory work, first, second, and third prizes, \$750, \$500, and \$250; for instructors, graduate students, or research fellows, first and second prizes, \$300 and \$200; and for undergraduate students, \$250. Contest rules can be obtained by writing to the Association, 1900 Arch St., Philadelphia 3, Pa.

* * *

Industrial Training Programs

How a manufacturer of equipment for the Armed Forces is meeting its need for production workers through apprenticeship and other forms of training is described in an article reprinted by the Bureau of Apprenticeship. Those interested can obtain free copies of the reprint ("Training Workers to Keep Pace with Increased Production"), by directing a request to the Bureau of Apprenticeship, U. S. Department of Labor, Washington 25, D. C., and mentioning MACHINERY.

INGENIOUS *Mechanisms*

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

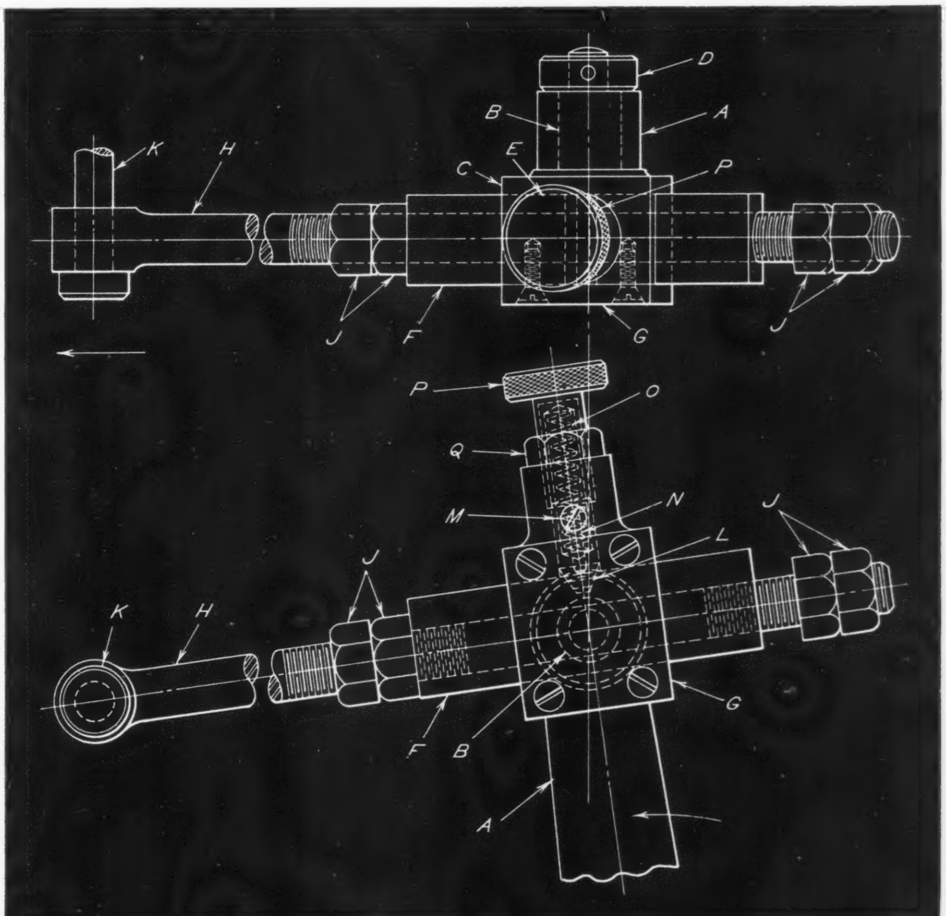
Safety Overload Mechanism Permits Adjustable Dwell on Reciprocating Drive

By W. M. HALLIDAY

Instant, safe, and automatic disengagement of the drive for a reciprocating machine slide when subjected to excessive load is obtained by means of the mechanism illustrated. A useful feature of this safety overload mechanism is that the period of dwell at each end of the reciprocating stroke can be varied by a simple adjustment. Also, the drive is instantaneously and automatically re-engaged when the overload has been removed. The mechanism is smooth and quiet in operation, and simple and inexpensive to make.

Driving lever *A*, which is fastened at its lower end to an oscillating shaft (not shown), swings through a constant arc. The upper end of the lever is bored to be a free swiveling fit on the cylindrical boss *B* of bracket *C*. Collar *D* is pinned to the shank end of this boss to hold the lever endwise without binding. The rectangular body of bracket *C* is slotted at *E* to hold rectangular sliding member *F*. Slide *F* is retained in the slot by a plate *G*, which is secured to the body by four screws.

Connecting-rod *H* is a sliding fit in a hole bored through slide *F*. The rod is threaded, as shown, to hold lock-nuts *J*, and the pre-set clearance between the inner nut face and the end of the slide determines the amount of dwell at each end of the stroke. If both pairs of nuts are screwed tight against the slide, there will be no dwell. The end of the connecting-rod is at-



The drive from oscillating lever (A) to a reciprocating machine slide which is attached to shaft (K) is disengaged by a spring-loaded plunger (L) when overloads are applied to the slide

tached to the reciprocating slide of the machine (not shown) by shaft K.

Slide F is connected to bracket C by a spring-loaded plunger L, the tapered nose of which fits into a V-notch machined across the slide. The plunger is a sliding fit within a boss on top of the bracket. It is prevented from rotating by a dog-point set-screw M which enters a shallow keyway N cut along the slide of the plunger. Spring O is seated in a blind hole in the plunger, and retained by a knurled-head adjusting screw P, which engages a threaded hole in the bracket boss. Screw P is held in any desired setting by lock-nut Q.

In operation, slide F and connecting-rod H move with driving lever A, thus reciprocating the machine slide. However, when additional resistance is offered to the horizontal movement of the machine slide—whether on its forward or return stroke—the plunger L will be forced out of the notch in slide F, thus disengaging the drive. When the overload is removed, the plunger will snap into the notch again, and the drive will be re-engaged.

By varying the compression of the spring, which is accomplished by screwing P into or out of bracket C, the point of loading at which the drive will be disengaged can be changed. Also, a heavier or a lighter spring can be used to suit requirements. For heavy-duty applications, where overload slippage is desired at high pressures, two plungers and slide notches may be employed, with the plungers mounted side by side in the same boss on bracket C.

Producing an Oscillating Movement of Uniform Angular Velocity

By PAUL GRODZINSKI

The mechanism here illustrated was designed to produce an oscillating motion having uniform angular velocity, using a crank A rotating at uniform speed as a driver. With the arrangement shown, an oscillating movement is imparted to lever C by connecting-rod B, but the angular velocity of this movement is not uniform. Although approximately uniform angular velocity could be obtained by arranging a suitable mechanism in front of the rotary crank, such devices are usually complicated and were not considered applicable in this case.

To achieve the desired results, the center position C_1 C_2 of lever C was taken as the axis of symmetry, and the mechanism on the left-hand side (crank A and connecting-rod B) was exactly duplicated on the right-hand side (crank A_1 and connecting-rod B_1). If crank A_1 were located on the same horizontal center line as crank A the angular velocity of crank A_1 would be uniform, but its oscillating movement would be through an angle of 180 degrees, which is not practical for uninterrupted operation. However, by lowering the center of crank A a distance X (from position D to D_1) keeping radius D_1 A_2 equal to DA_1 and leaving the mechanism on the left of the axis of symmetry in its original position, oscillation angles of 120 to 150 degrees, which are permissible, are obtained. Graphical analysis of the angular velocity of crank A_1 will produce a curve like that shown at the bottom of the illustration.

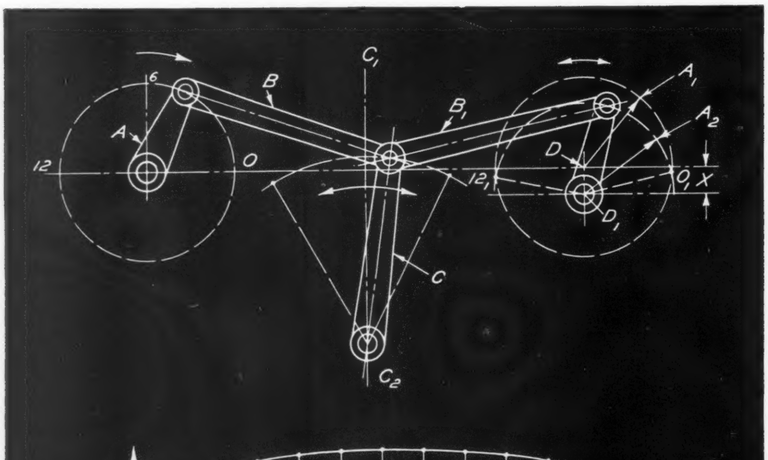


Diagram showing method of obtaining an oscillating movement of approximately uniform angular velocity from a rotating crank

TOOL ENGINEERING *Ideas*

Tools and Fixtures of Unusual Design and Time- and Labor-Saving Methods that Have been Found Useful by Men Engaged in Tool Design and Shop Work

Milling Fixture with Cam-Actuated Clamp

By ROBERT MAWSON

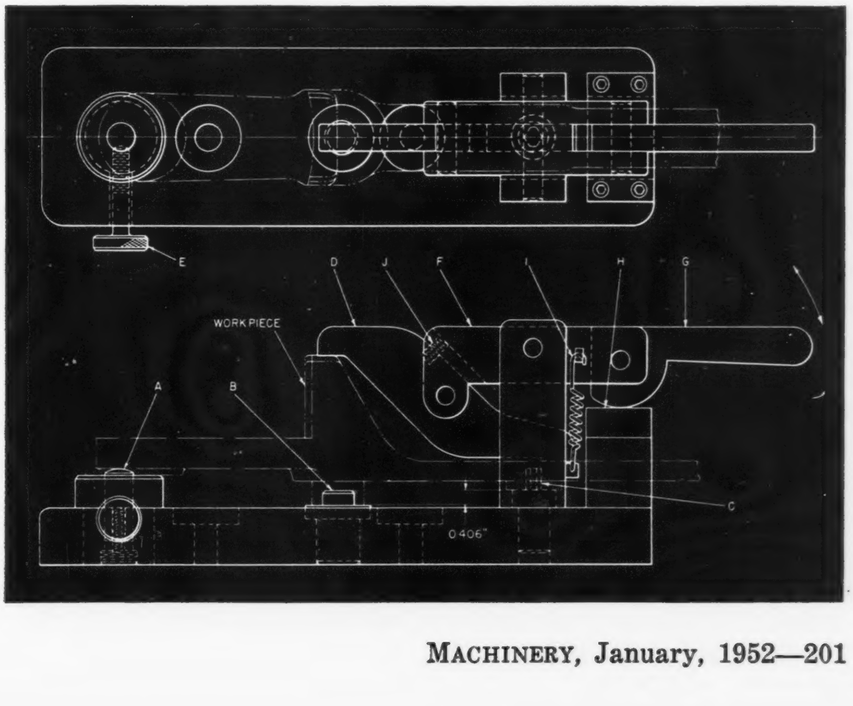
A milling fixture designed by the George Gorton Machine Co. for rapid and easy set-up in machining tracer arms of engraving machines is shown in the accompanying illustration. The important feature of this fixture is the clamping device, which applies pressure on the work at two points by a single movement of a cam type lever. The operation performed is the finish-milling of a radial surface.

Three locating pins *A*, *B*, and *C* position the tracer arm in the fixture. Surrounding these pins are ground surfaces which support finish-machined bosses on the arm. A cam-actuated clamp *D* secures the work in place.

Pin *A* is a spring-loaded plunger which can be depressed and locked in place by means of a knurled-head screw *E*. Pin *B* forms part of a stepped cylindrical unit which is a press fit in a hole in the base of the fixture. A similar unit, differing only in that the pin *C* is diamond-shaped, is a press fit in another hole in the fixture base.

Clamp *D* is connected by a rocker arm *F* to a cam *G* which acts against a cam-plate *H*. When the lever on the end of the cam is depressed, the movement of the rocker arm causes pressure to be applied by clamp *D* to the tracer arm in two places, as seen in the illustration. For loading and unloading, the clamp is held in a withdrawn position by means of the springs *I* and *J*.

In loading, locating pin *A* is depressed and locked if not already in this position. The tracer arm is then placed in the fixture from the left and positioned on pins *B* and *C*. Pin *A* is now unlocked to permit it to rise and enter a hole in the work, which further positions it. Next, the tracer arm is clamped by moving the cam lever in a clockwise direction. The unloading is accomplished by moving the cam lever in a counter-clockwise direction and depressing pin *A*. This permits the tracer arm to be lifted from the other two pins and removed from the fixture.



Milling fixture that employs a cam-actuated clamp to secure the work-piece in place during the final machining operation

Tooling for Machining Check-Valve Plungers

By ROBERT W. NEWTON, Poughkeepsie, N. Y.

At first glance, the check-valve plunger shown in the detail views of the accompanying illustration appears simple to machine. It seems as though it would be necessary only to face, form, tap, and cut off the part on an automatic screw machine; centerless-grind the outside diameter; and mill the three radii to form the wings.

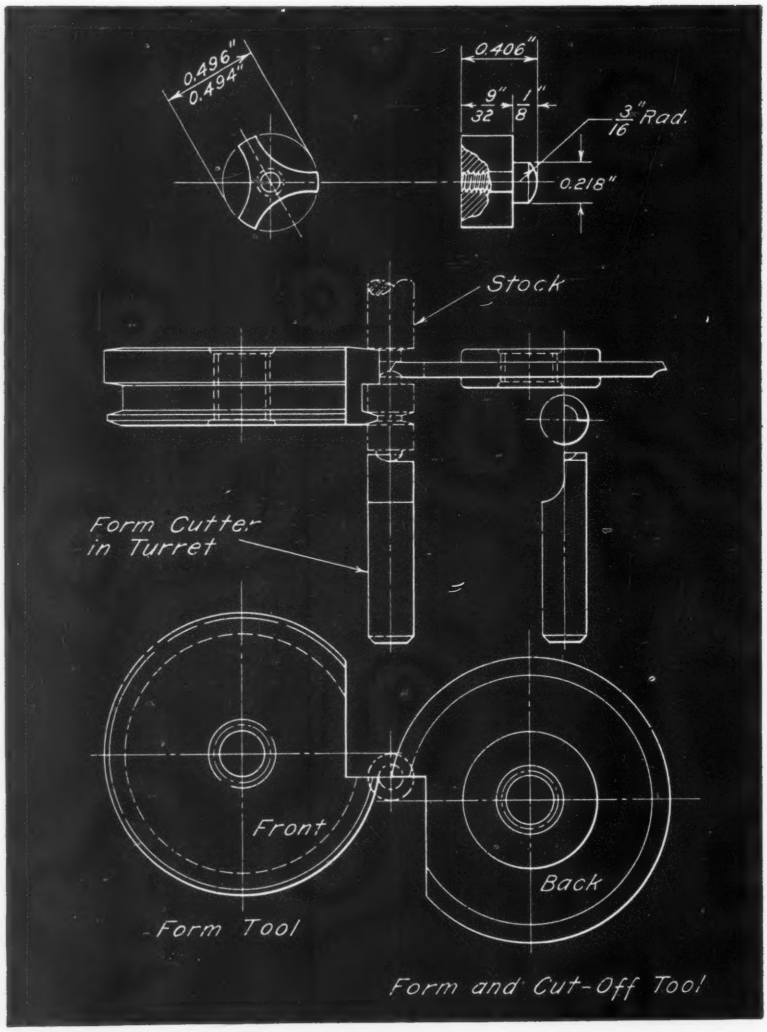
However, it is impractical to hold this piece in the collet of an indexing head for milling the wings because the small-diameter end is only 1/8 inch long. To provide a sufficient length of stock for gripping rigidly in a collet, two of the parts are formed on the automatic in one piece. Then, after milling each end, the piece is cut through the center to make two parts.

In the first operation, performed on an automatic screw machine, the stock is chucked to a length of approximately 1 1/8 inches. A 3/16-inch radius is formed on one end of the piece by means of a forming cutter held in the turret of the machine. Then, a forming tool, mounted on the front of the machine, is used to plunge-cut a groove, 1/4 inch in diameter by 1/8 inch wide, between the first and second parts. This groove has angular sides to provide additional strength. The same tool also plunge-cuts a groove, 0.218 inch in diameter by 3/8 inch wide, which forms the small-diameter ends on the second and third parts and allows 1/8 inch between them for subsequent cut-off.

An end-forming and cut-off tool, mounted on the back of the lathe, forms the 3/16-inch radius on the other end of the piece and cuts the piece off to a length of 15/16 inch. The thickness of the cut-off tool is such that 1/64 inch of stock is left on the formed end of the bar for forming the end radius on the next piece.

The next operation is performed on a centerless grinding machine, the outside of the part being ground to a diameter of between 0.494 to 0.496 inch. Then the piece is gripped in the collet of an indexing head—on one of its 0.496-inch diameter ends—and the radii to form the wings are milled in the other end. After this, the piece is reversed in the collet and the second end is milled.

Following milling, the piece is cut through the center, making two pieces. A cut-off blade 1/16 inch thick is used for this operation, which is performed on a semi-automatic screw machine. Finally, in the same machine, the end of each piece is faced to length, and the hole is drilled, chamfered, and tapped.



Set-up employed on an automatic screw machine to form a piece that is subsequently cut apart to produce two check-valve plungers

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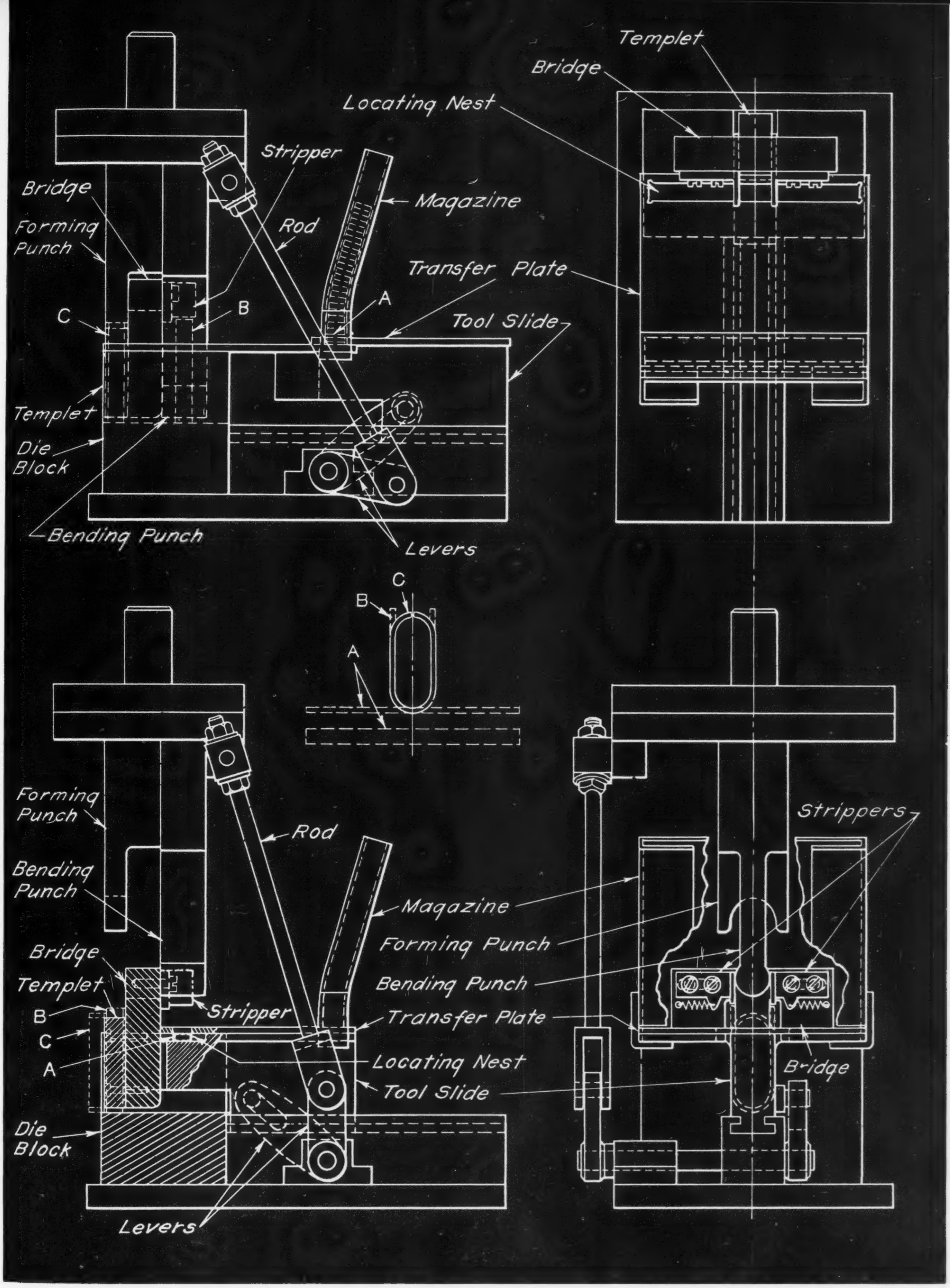
Simple Two-Station Die for Forming Clips

By WOLFGANG HAMERSCHLAG
Graz, Austria

Dies required for forming clips generally present difficulties because they are either too slow or too expensive to build. The simple two-station die illustrated offers a solution to such problems.

A plan and a side view of one of the blanks used for forming the clips are shown by the dotted lines at *A* in the center of the drawing. The blank is bent to a U-shape, as



Clips such as the one seen at (C) in the center sketch are quickly formed from flat sheet-metal blanks (A) on this simple two-station die. A magazine feed is provided for semi-automatic operation

indicated at *B*, in the first station of the die. A completely formed clip is shown by full lines at *C*. The die is equipped with a magazine feed for semi-automatic operation; it can be equipped with a coil-feed device and cut-off mechanism for automatic use.

In operation, sheet-metal blanks are stacked in the magazine, and on the down stroke of the press ram, a transfer plate, secured to the tool-slide, is drawn back until an opening in the plate is directly below the magazine, as seen at the upper left. The tool-slide is actuated by

levers, which are connected by means of an adjustable rod to the top plate of the die set. The bottom blank in the magazine falls into the opening in the transfer plate, as seen at *A* in the upper view. When the press ram rises, the blank is carried forward and dropped into a locating nest in the die-block seen at *A* in the lower view.

On the next downward stroke, the bending punch forces the blank into a cavity in the die-block at the first station, thus shaping it into a U-form, as seen at *B* in the upper view. As the ram rises, the tool-slide pushes the U-shaped blank along the cavity in the die-block and on a template at the second station. This position of the blank is indicated by *B* in the lower view. Simultaneously, another flat blank is transferred from the magazine to the locating nest.

When the ram again descends, the U-shaped part is closed by the forming punch to complete the clip, as seen at *C*, and the flat blank is bent into a U-shape. This cycle is repeated continuously as long as the press is in operation and the magazine is supplied with blanks. A blank is automatically brought forward from the magazine and a finished clip is pushed off the template by a U-shaped blank at each stroke of the press.

The template is secured to the front face of the bridge by screws, and the bridge is attached to the top of the die-block. The bridge also carries two strippers, which are normally held in their outer positions by springs connected to pins projecting from the back face of the bridge.

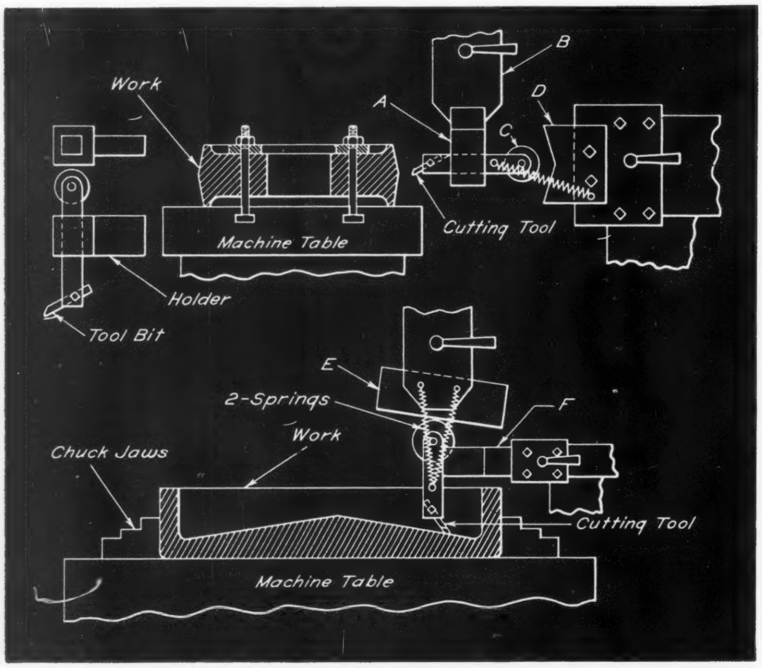
When the flat blank is being folded to a U-shape, the legs on the partially formed clip pull the strippers toward each other into the recessed sides of the bending punch. As the bending punch reaches the bottom of its stroke, the ends of the partially formed blank snap under the bottom edges of the stripper. The part is thus retained in the die upon the upward movement of the bending punch.

Turning Formed Parts to a Template on a Vertical Turret Lathe

By J. C. KAISER, Newark, N. J.

The accompanying illustration shows two applications of the use of a template, or master form, for turning formed parts on a Bullard vertical turret lathe. In the arrangement seen in the upper part of the illustration, a tool-holder *A* is held in the turret-head *B*. The tool-holder is equipped with a spring-loaded roller *C*, which follows the contour of a template *D* held in the cross-slide. By moving the master form into contact with the roller, the tool moves into the work in accordance with the form of the template, thus turning the crown of the pulley as the head is fed downward. Another tool (as shown at the left in the upper view) also contained in a holder having a roller, is employed in a similar way to turn the outside diameter.

In the lower part of the illustration, a set-up for turning an angular form is shown. Here the master *E* is held in the turret-head and the tool-holder *F* in the cross-slide. In this case, two heavy springs are used to provide tension against the master when turning an angular form inside a tank, held in a chuck on the machine table.



Two applications of templates and followers employed in a vertical turret lathe for turning formed parts. The upper view shows the arrangement for turning the crown of a pulley, while the lower view shows the set-up for turning an angular form

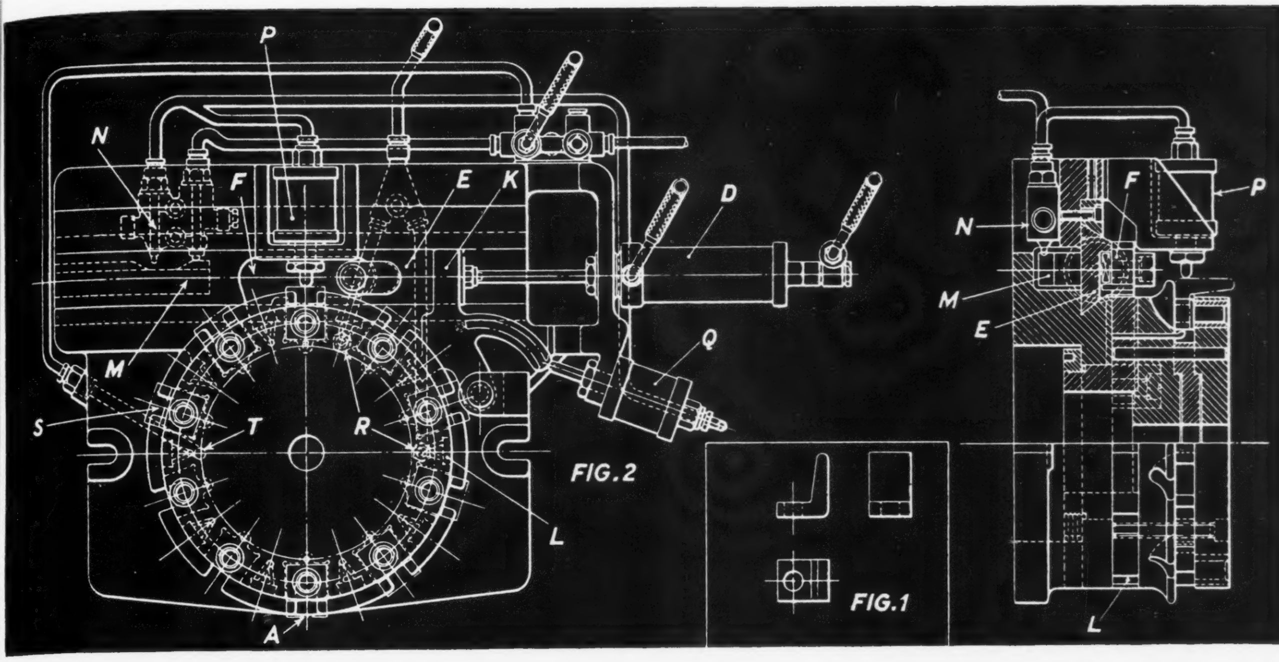


Fig. 1. The hole in this copper contactor tip is drilled by means of the automatic jig shown in Fig. 2, which locates, clamps, indexes, and ejects the part. Fig. 2. Plan and sectional view of automatic drill jig with pneumatic indexing, clamping, and unloading features

Pneumatic Indexing, Clamping, and Work Ejecting Jig for Automatic Drilling

The time occupied in locating and clamping small components in drill jigs, and in removing them after completing the operation, is often out of proportion to the actual machining time. The pneumatic jig here described was designed to facilitate drilling the hole in the copper contactor tip shown in Fig. 1, and to reduce locating, indexing, clamping, and ejecting time.

The contactor tip to be drilled is placed in locating nest *A*, Fig. 2, at the front of the jig. The drilling machine feed lever is then retracted to its highest position, causing the cam *B*, shown in Fig. 3, to actuate valve *C* through lever *G* and thus admit air to one end of cylinder *D*, Fig. 2. This brings the pawl-slide *E* and pawl *F* into the indexing position.

As the operator feeds the drill spindle down, cam *B* on the feed disk leaves the valve operating lever *G*, which is then returned by the spring *H*, thus reversing the setting of valve *C* and admitting air to the opposite end of cylinder *D*. Then

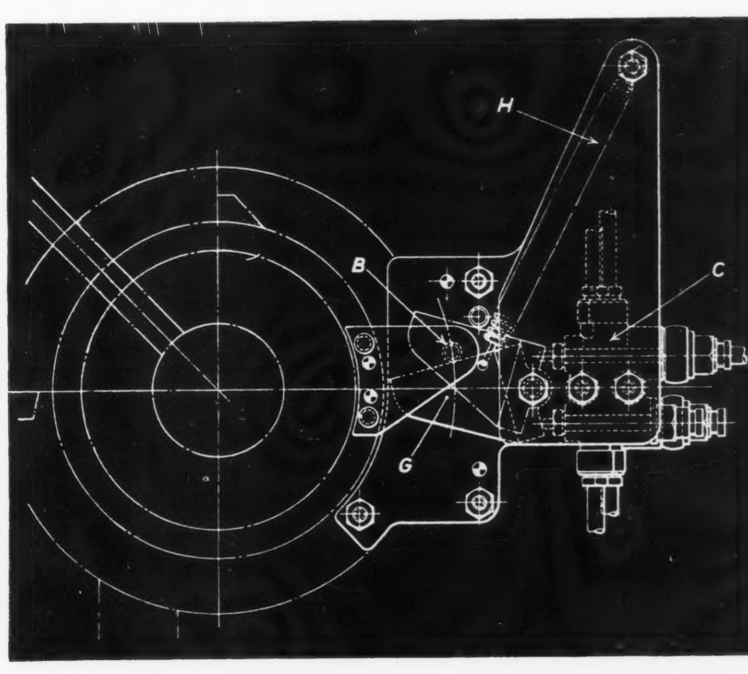


Fig. 3. Valve operating mechanism for the jig shown in Fig. 2 is installed on the drilling machine feed disk

slide E, on which pawl F is pivoted, moves to the left to index the jig and bring the next part into the drilling position.

To insure correct indexing, latch-stop K engages one of the slots L in the index-plate. A cam M on pawl-slide E automatically actuates the valve N, thus admitting air to cylinder P, which clamps the part in the indexed position. The air cylinder Q is also controlled by valve N, and serves to hold latch-stop K in position against the pressure of indexing pawl F. Air pressure in cylinder P is released when valve N is operated by the return of pawl-slide cam M to its free position. Movement of the pawl-slide also disengages latch-stop K, and thus frees the fixture for indexing to the next position. Air exhausted from cylinder D on the return stroke of slide E is used to blow away any chips from the indexing slots in positions R.

As the drilled part S passes over hole T, to which the air supply is connected, it is ejected and the locating nest is blown clear of chips. The nest is then ready for another piece.

Fixture for Milling Helical Slots in a Drill Press

By JOHN J. McNEFF, Irving, Tex.

The fixture shown in the accompanying illustration was designed for milling helical slots in fasteners for aircraft cowlings. These fasteners, indicated by dot-and-dash lines, were turned in an automatic screw machine, but the helical slot required through the body had to be produced as a secondary operation. This was accomplished in a drill press with the fixture shown.

In operation, a turned fastener is placed in a fixed jaw B, which is an integral part of the spindle C, and a movable jaw D, actuated by the screw E, grips and holds it in position. After an end-mill in the drill press chuck passes through the hole in the part, a cam-shaped slot in the fixed bushing F is engaged by the roller I, attached to the work-spindle shank. The roller travels in a helical path while the work-spindle is rotated by gears G and H. When the end of the slot J is reached, spring tension locks the roller in place.

The roller travel, and therefore the forward helical movement of the spindle, moves the work as required against the end-mill. The end of the cutter is supported by the revolving bushing L, held in ball bearing M.

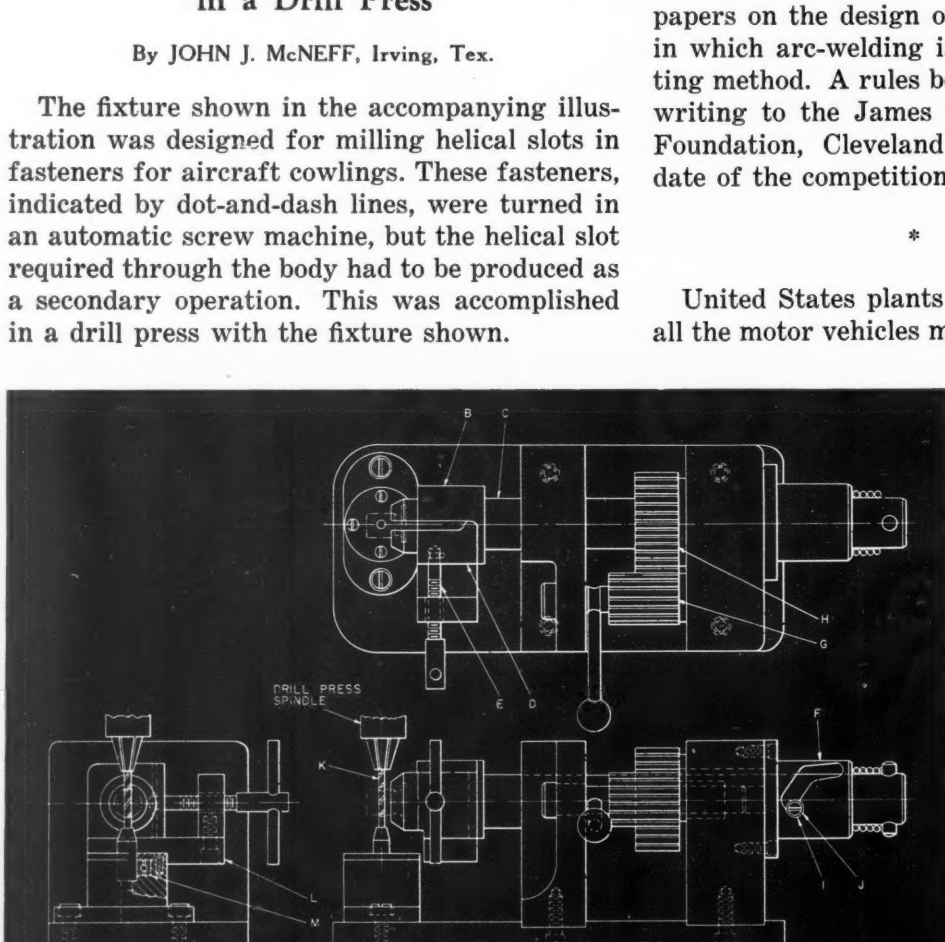
* * *

Welding Paper Competition for Undergraduate Engineers

For the fifth consecutive year, the Lincoln Arc Welding Foundation has announced a competition to encourage undergraduate engineers to study arc-welding technology and its economies. Awards totaling $6,750 will be made for the best papers on the design of machines or structures in which arc-welding is utilized as the fabricating method. A rules booklet can be obtained by writing to the James F. Lincoln Arc Welding Foundation, Cleveland 17, Ohio. The closing date of the competition is May 31, 1952.

* * *

United States plants produced 76 per cent of all the motor vehicles made in the world in 1950.



Drill press fixture employed for milling a helical slot in fasteners for aircraft cowlings

Questions and Answers

A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

Default in Payments on Conditional Sales Contract for Machinery

A. W. C.—We sold a machine on a contract. The purchaser paid $500 down, and was to pay the balance $50 per month. He paid nothing after receiving the machine, stating that he could not use it. Can we repossess the machine?

Answered by Leo T. Parker, Attorney at Law
Cincinnati, Ohio

Yes, you can repossess the machine. If machinery is sold under a conditional sales contract, and the seller retains title to it until the purchase price is paid, the seller can reposses the equipment from anyone in whose possession it is at the time the purchaser defaults in making the payments agreed upon.

In Stanfield vs. Crawley [39 S.E. (2d) 88], a purchaser signed both a conditional contract and a note for $432, the balance due. The purchaser refused to make agreed monthly payments on the grounds that the machine was "worthless." The seller sued for possession of the machine. In holding in favor of the seller, the higher court stated, "Where property is conveyed by a conditional sales contract the vendor (seller), in case of default in the payments, may obtain possession of the property from one in possession of the same."

In other words, it is immaterial that a purchaser sells, gives, or otherwise permits a third person to possess the merchandise. However, if you did not record your contract, and, without your knowledge, the purchaser sold the machine to another, then you cannot repossess it.

Flame-Cutting of Nickel-Alloy Steels

D. S.—Can you inform me whether there is any difficulty in cutting the standard types of nickel-alloy steels with an oxy-acetylene flame?

Answered by Editor, "Nickel Topics," Published by the International Nickel Co., Inc., New York City

Some time ago we had occasion to look into this question, and found that the ordinary grades of nickel-alloy steel can be handled by flame-cutting without difficulty. The lower carbon content steels of this type can be readily cut cold and otherwise fabricated without heat-treatment. Steels containing carbon in excess of 0.30 or 0.35 per cent should be preheated to 500 to 600 degrees F. and cut while at this temperature. If the carbon content exceeds 0.50 per cent, preheating should be followed by annealing. The annealing is accomplished by heating to 1450 to 1500 degrees F. and cooling slowly. In some cases, slow cooling from the preheating temperature and prompt machining of the cut surface will avoid the necessity of annealing.

* * *

Machine Tool Industry Granted Preferential Status for Controlled Materials

A procedure for granting the machine tool industry preferential status on orders for controlled materials and component parts was established on December 11 by the National Production Authority. The new procedure provides a program symbol "Z-2" which will have the same urgency status as symbols A, B, C, and E that identify the programs of the Defense Department and the Atomic Energy Commission.

The new urgency symbol will work as follows:

1. NPA will authorize a machine tool builder to substitute the program symbol Z-2 for the N-8 symbol on orders for steel, copper, and aluminum, as well as on purchase orders for component parts.

2. Upon receipt of the authorizing letter, the manufacturer will revalidate his outstanding orders with the new symbol, and also will be able to use this symbol in placing new orders.

3. A steel mill, or other supplier of controlled materials or components, on receipt of an authorized order bearing the symbol Z-2 is required to give it the same priority as is now given the A to E coded orders "unless his order books for a particular product are filled for that product for a particular month."

The new program symbol does not grant any authority to a manufacturer to exceed his controlled materials allotment. It is simply intended to assist the machine tool industry, which is expanding its production by 400 per cent compared with its pre-Korea base.

THE SALES ENGINEER AND HIS PROBLEMS

By BERNARD LESTER
Lester and Silver
Sales Management Engineers
New York and Philadelphia

Will I Do a Better Selling Job This Year?

HERE'S a question to ask ourselves at the start of any year: "Are my sales methods improving as fast as equipment and manufacturing methods?" Progressive improvement in equipment design and manufacture is essential. Even more necessary—with our changing market—is an improvement in the way we engineers sell what is built.

Someone has said that employes of modern manufacturing concerns are divided into three classes—"thinkers up," "get doners," and "doers." The theory is that one group originates ideas, another directs their execution, and the third actually puts these ideas into effect by coordinating mind and hand.

While this is true in a general sense, such a classification is a pretty rough one. The work of the sales engineer, for example, can't be pigeonholes. He belongs in all three groups. He is an inventor, a boss, and a worker—all in one. He must think up and devise new methods and tactics. He must get others to act. He must use his own mind and his own legs as an individual performer.

These three lines of effort are absolutely necessary if we are to do a better job during the present year. Though we may be good, we are sure to discover some deficiency in our past sales performance.

The Sales Engineer Must be a "Thinker Up"

Every good technical designer thinks up new ideas. He is resourceful. He should be unprejudiced and free from time-accumulated barnacles which hinder sailing forward. Too many sales engineers are selling today just as they did twenty years ago because their minds are not open to accept new ideas and to make use of every opportunity.

Recently, a machinery salesman lost a big equipment job. He lost it, he said, because his company required a substantial down payment on the equipment. But further analysis showed he did not contact all the purchasing people who might have been induced to swing the job his way. The reason he lost the business was not the one he gave. The real reason was that he didn't do a complete selling job.

The Sales Engineer Must be a "Get Doner"

Every one of us has the job of getting other people to act. It may be those in our own office or those at our factory headquarters. And what's more, to do a complete selling job, we often have to get someone in the prospect's organization to do something—tell the purchasing engineer what he thinks; get our equipment favored or sketched in a drawing or lay-out plan; ask someone to introduce us to a person we haven't met; get a consulting engineer or contractor to say a good word for us and our equipment.

In getting orders our skill is in making other people act, not so much by command as by persuasion. How many of us, blaming our factory, finally pick up the phone and proceed to "dress down" the very man who should be on our side and working for us?

The Sales Engineer Must be a "Doer"

Few will argue about the statement that the sales engineer must be a doer. Unless our legs carry us right to the prospect and our minds cleverly guide the expression of the right idea at the right time, we can't be doers. Countless orders are lost by salesmen who say, "Well, I don't think that fellow will ever buy from me,"

or who look out of the window on a raw, blustery day and think how much more comfortable it is to stay right in the office.

The cleverest machine designer produces a balanced design—one that can be built well and cheaply; one that can give the best results to the user; one that has appeal and can be sold. Each point of excellence has a relation to its importance, and a proper balance in these features results in the best over-all design. Seldom, if ever, has one machine design a higher rating in every particular over competitive design.

The same principle applies to selling. Every move in selling, to be successful, must be in proper relation to the needs and character of the prospect. We have to strike the hammer blows of selling where they will count for the most. We must be "thinkers up," "get doners," and "doers"—all in one. As we size up our work for the past year, and plan to improve it this year, let's take a look at ourselves!

* * *

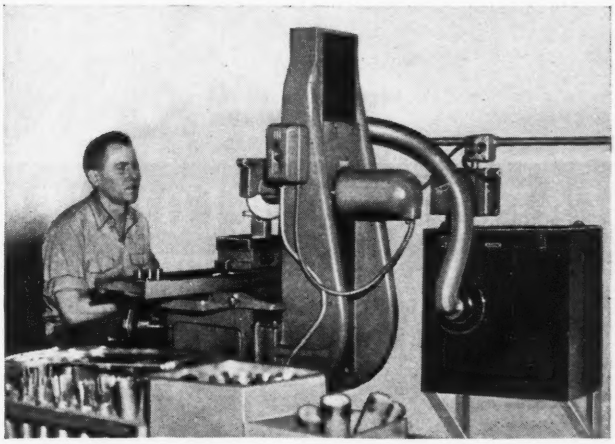
Selling to the Armed Services

In order to provide a concise guide for companies interested in getting defense contracts and sub-contracts, the Department of Manufacture of the Chamber of Commerce of the United States, Washington 6, D. C., has prepared a bulletin entitled "Six Steps in Selling to the Armed Services."

The subject is discussed under the following headings: Know government buying procedures; make your plant capabilities known; find the right buying office; sell as strongly as in commercial practice; seek sub-contracts as well as prime contracts; know when and when not to visit Washington. Those interested can obtain copies of this publication from the Chamber of Commerce at the address given above. The price is 15 cents per copy.

* * *

Over 85 per cent of the total value of machine tool shipments in the United States during 1950 was accounted for by companies located in the New England and East North Central states. Ohio ranked first with $94,000,000, or 31 per cent of the total, and the five East North Central states—Ohio, Indiana, Illinois, Michigan, and Wisconsin—accounted for 60 per cent of the total. Machine tools were produced in twenty-seven states during 1950. Shipments were made by 395 companies, and the total value was $303,000,000, according to the Bureau of the Census, Department of Commerce.



Collecting valuable diamond dust in a surface grinding operation. To conserve floor space, the unit is mounted on wall brackets beside the grinder. A flexible hose terminating in a standard wheel hood permits efficient collection of the diamond dust

Dust Collector Helps Pay for Diamond Grinding Wheels

Diamond dust from a worn-out grinding wheel is very valuable, and it can be easily recovered if the grinding is done wet. But in dry grinding, if the dust goes into a big centralized dust collecting system, the valuable specks of diamond are almost impossible to find in a bushel of miscellaneous dust. However, when the diamond dust particles are concentrated in a relatively smaller amount of miscellaneous dust, it is an easier matter to separate them.

Since there is usually only one diamond grinder in use at any one location within a plant, the easiest method of recovering the diamond dust is to use a separate unit type collector. The branch pipe is simply disconnected from the general dust collecting system and a unit type collector substituted.

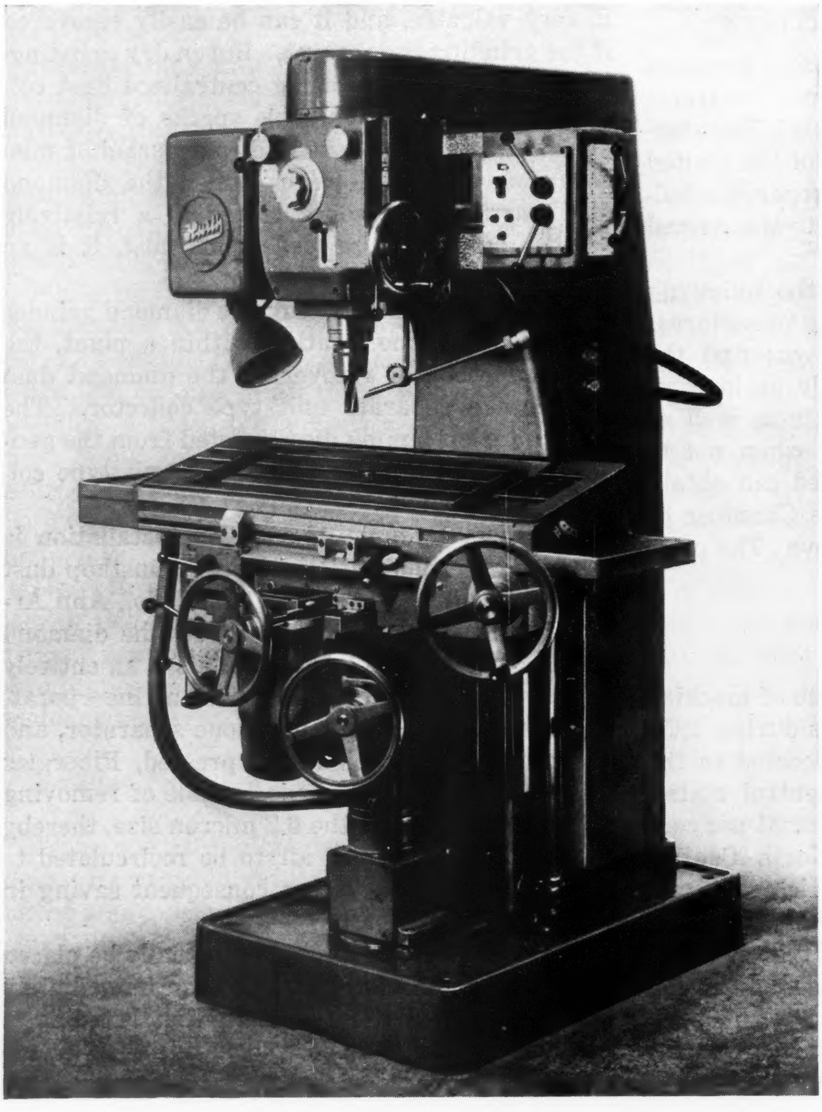
A typical example of such an installation is shown in the illustration. Here a Dustkop dust collector, built by the Aget-Detroit Co., Ann Arbor, Mich., is being used to collect the diamond dust from a surface grinder. This is an entirely self-contained dust collecting system, incorporating a motor-driven fan, a cyclone separator, and a second-stage, specially compressed, Fiberglas filter. This type of filter is capable of removing all fine dust down to the 0.2 micron size, thereby permitting the cleaned air to be recirculated to the working space, with a consequent saving in heat.

This model dust collector can usually be placed under the table of the grinder, or immediately behind it. In the installation illustrated it is put on a bracket on the wall beside the surface grinder to save floor space.

LATEST DEVELOPMENTS IN *Shop*

Precision Tool-Room Boring and Milling Machine

Vertical milling, "down feed" milling, and jig boring can be performed with a single machine and a single set-up of the work in the Hurth precision boring and milling machine here illustrated, which is being placed on the market by the Kurt Orban Co., Inc., 21 West St., New York 6, N. Y. Longitudinal traverse of the work-table, which can be tilted 15 degrees in two directions, is used for vertical milling, while longitudinal traverse of the table and graduated "down feed" of the cutter-spindle is employed for "down feed" milling. The continuous spindle "down feed" can be varied by extremely small steps for jig boring.



While this machine is specifically designed for the precision machining of jigs, fixtures, molds, dies, gages, and other tools, it is equally well adaptable for long-run production work. The work-table has an area of 11 3/4 by 39 1/4 inch. It is provided with a longitudinal traverse—either power- or hand-operated—of 15 3/4 inches, and a hand-operated transverse movement of 9 1/2 inches.

Vertical knee adjustment of 14 inches is obtainable by power or hand operation. Thirteen spindle speeds, ranging from 45 to 2800 R.P.M. are available. Nine feed rates of from 0.22 to 3.54 inches per minute are obtainable for each

Fig. 1. Hurth precision boring and milling machine with tilting work-table. Vertical milling, "down feed" milling, and jig boring can be performed on this machine with a single set-up of the work

Equipment

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on Market

Edited by FREEMAN C. DUSTON

spindle speed in boring. The spindle-head slide can be traversed at nine speeds varying from 2 to 31.5 strokes per minute, and the spindle can be fed downward at ten rates ranging from 0.002 to 0.020 inch per traverse.

There are six longitudinal feeds for the table—from 5/8 inch to 6 1/4 inches per minute. Maximum vertical travel of the spindle is 3 15/16 inches, while maximum traverse of the spindle head is 5 29/32 inches. The maximum vertical distance from the spindle nose to the table is 19 3/4 inches.

Fig. 2 shows the machine equipped with a swivel circular table 19 3/4 inches in diameter. This table can be rotated at six speeds varying from 6.8 to 68 R.P.M., and indexed by 15-degree intervals. Guideways of both the work-table and cross-slide serve as reference axes for work by rectangular coordinates, while the circular table, when placed on the work-table, enables work to be performed by polar coordinates.

The direction of movement of the work-table, as well as the cross-slide, can be adjusted either by means of rules and large-size graduated collars reading to 0.001 inch or, in cases where greater accuracy is required, by gage-blocks, as seen in Fig. 3. The machine is fitted with gage-block measuring equipment, the gage-blocks being brought into contact with dial indicators reading to 0.0005 inch, and correct settings being indicated by the pointers registering with the zero marks.

Hydraulic-Jack Type Center-Hole Puller

A high-tonnage capacity hydraulic-jack type puller has been brought out by Templeton, Kenly & Co., 1020 S. Central Ave., Chicago 44, Ill. This Simplex "Jenny" center-hole puller has a capacity of 600 tons, and is operated by a 10-H.P. motor. It is double-acting, and is especially adapted for use in large electric plants. Two hand-pumps are incorporated to permit raising the tonnage gradually.

The travel range is 6 1/2 inches. The center hole diameter is 7 3/4 inches; the outside diameter, 22 inches; and the height, 21 inches. The jack can be used to push or pull in a straight line, vertically or horizontally.

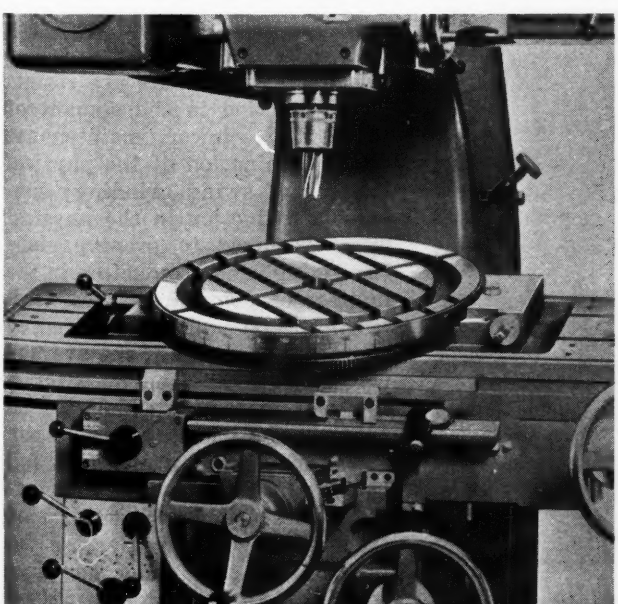


Fig. 2. A circular indexing table, mounted on the tilting work-table of machine in Fig. 1, enables work to be performed by polar coordinates

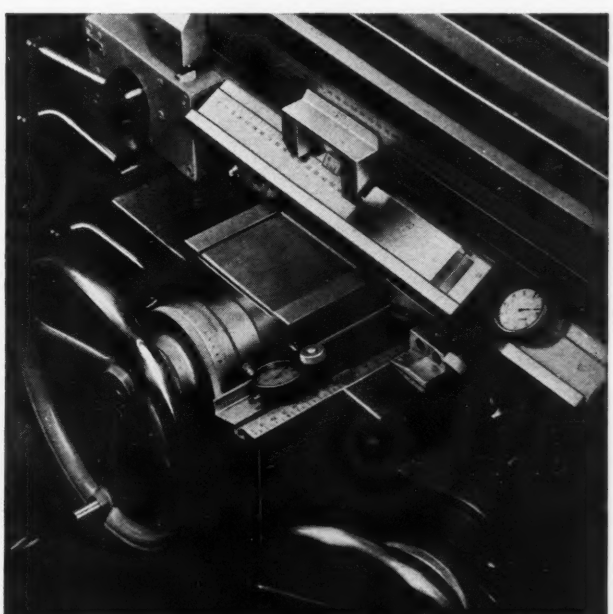
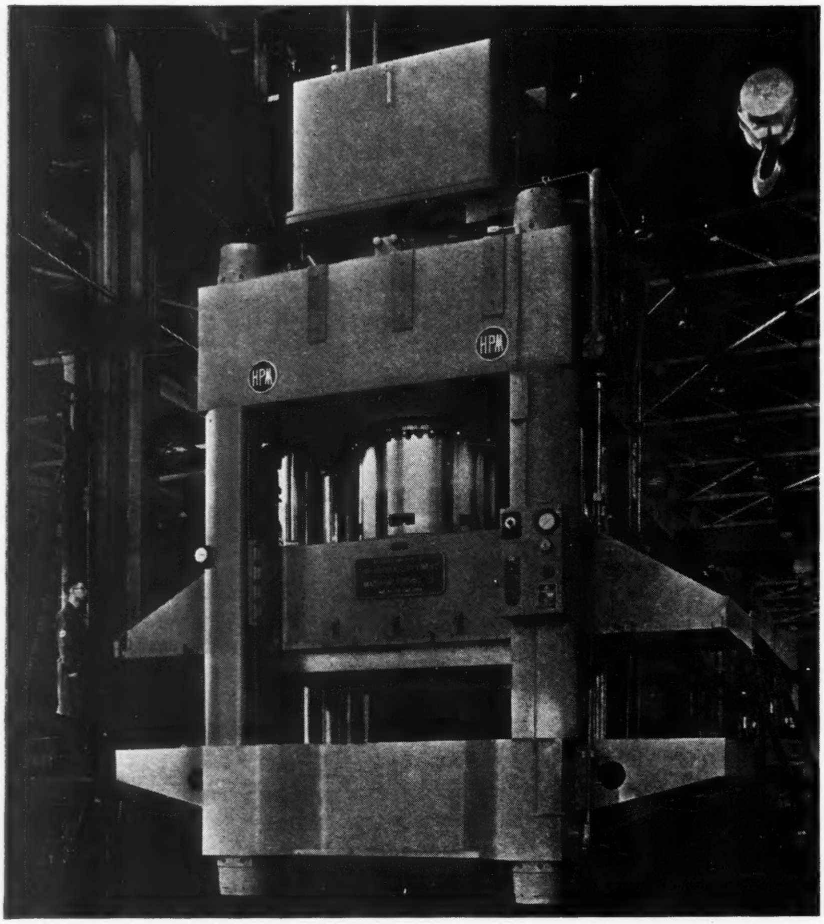


Fig. 3. Graduated collars, vernier scales, gage-blocks, and dial indicators permit accurate adjustments on machine shown in Fig. 1



Large armor plate, from 1/2 inch to 2 inches thick, is quenched in a new press built by the Hydraulic Press Mfg. Co.

Armor-Plate Hydraulic Quenching Press

Armor-plate quenching presses are now being built by the Hydraulic Press Mfg. Co., 1042 Marion Road, Mount Gilead, Ohio. These giant 2500-ton presses have a bed size of 72 by 235 inches, and will handle large plates from 1/2 inch to 2 inches thick. Clearance between the rod shields is 98 by 72 inches.

In operation, hot armor plate from the hardening furnace is placed in the press and held under pressure between the dies while being sprayed with cold water. Prior to the development of this hydraulic press quenching method, the plate had to be straightened after it was cooled on mechanical presses, which permitted only a small portion of the plate to be straightened in the press at one time. This slow and tedious process, which took hours to perform, is handled by the new armor plate quenching press in less than two minutes, and subsequent straightening operations are entirely eliminated.

Automatic machine for grinding large surfaces of steel slabs developed by the Mid-West Abrasive Co.

Automatic Grinder for Finishing Steel Slabs

An entirely new type of automatic grinding machine developed for use in finishing steel slabs in the manner shown in the accompanying illustration has been brought out by the Mid-West Abrasive Co., Owosso, Mich. It is claimed that this hydraulically actuated grinder can be operated with greater ease and accuracy than conventional swing-frame grinders, and that its use results in a reduction in the amount of metal lost; lower maintenance costs; elimination of the physical hazards of swing grinding; substantial reduction in the physical effort required to prepare slabs for rolling; and a reduction in the number of grinding wheels used.

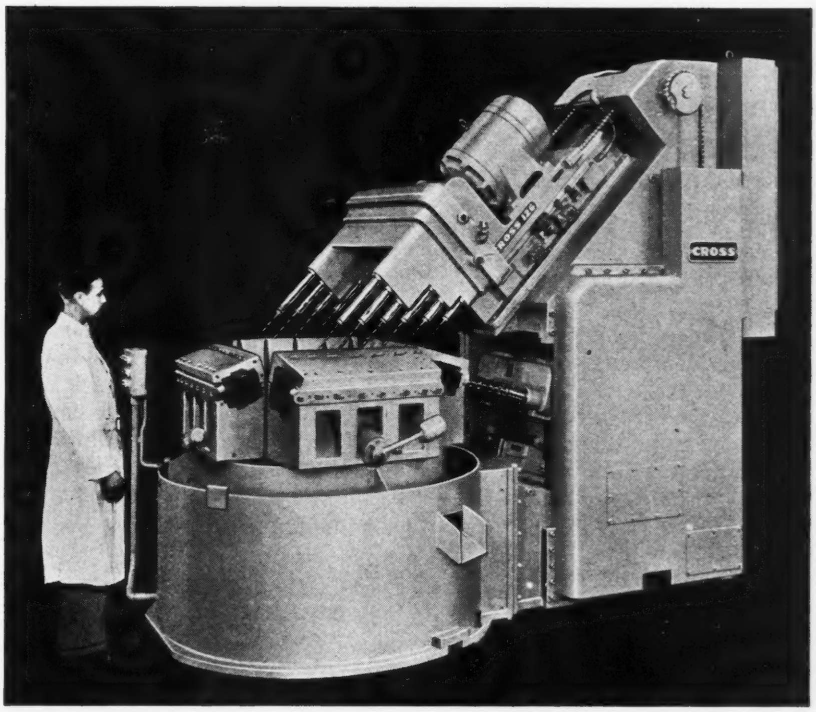
No special skill is required to operate this machine, the average worker becoming adept after a few hours practice. Mounted on a track, the machine can be run back and forth along the full length of the slab, while the snagging wheel can be raised or lowered, tipped, or moved across the face of the slab under complete control of the operator seated on the traveling machine.

Cross Machine Designed for Finishing Cylinder Heads

A special machine for drilling and chamfering cylinder heads has recently been built by The Cross Company, Detroit 7, Mich., for a large automotive company. This machine drills twelve angular holes and countersinks eight manifold mounting holes in 170 pieces per hour. Only one unskilled operator is required.

An outstanding feature of the machine is the heavy-duty index-table. This incorporates a manual as well as an automatic control cycle. In machines of this type, the index-table sometimes becomes jammed, due to improper loading or carelessness on the part of the operator. On the Cross unit, a fluid motor drive prevents damage to the table under these conditions. The construction is such that it is simple to reverse the rotation, remove the obstruction, and continue the operation.

Among the features are hardened and ground ways; hydraulic feed; and construction to J.I.C. standards with stranded wire electrical installation. The machine is composed of standard Cross subassemblies to facilitate maintenance, reduce "down" time, and provide flexibility for part design changes.

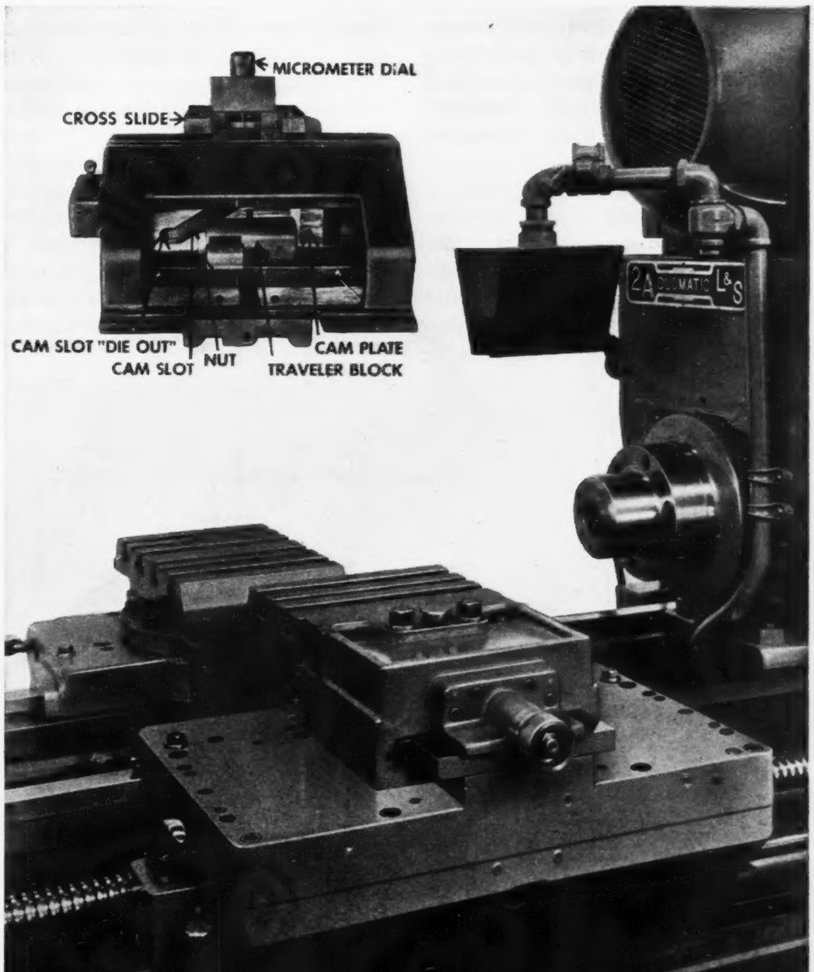


Special machine for drilling and chamfering cylinder heads, designed by The Cross Company

Cam-Operated Rear Cross-Slide for Lodge & Shipley Duomatic Lathe

A cam-operated rear cross-slide is now available on the Duomatic lathes manufactured by the Lodge & Shipley Co., 3071 Colerain Ave., Cincinnati, Ohio. This cross-slide, which provides greatly increased rigidity, is designed particularly for forming, grooving, necking, and similar operations. Significant production increases are claimed to result from the new design, which replaces the former rack and pinion slide. The heavier, more rigid slide is said to be capable of handling even the most difficult forming cuts. In cases where it is desired to perform turning operations with the rear slide, a rack and pinion cross-slide can be furnished at additional cost.

The cam, which feeds the slide into the work-piece, has been so



Lodge & Shipley Duomatic lathe equipped with a cam-operated rear cross-slide which provides greater rigidity in forming

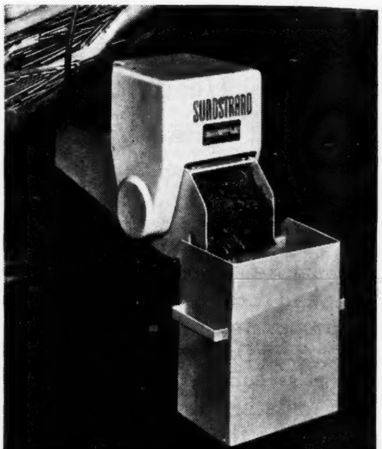
constructed as to move the slide inward at a constant rate. As the tools approach the end of their stroke, the inward feed is gradually decreased by the action of the cam. With this arrangement, uniform diametral accuracy of the work is insured.

Struthers Wells Roller-Table Bending Machine

A roller-table bending machine capable of cold stretch-forming a variety of structural shapes and sheet-metal parts that are usually hot-formed is a new development of the Machinery Division of Struthers Wells Corporation, Titusville, Pa. Believed to be the most powerful machine of its type, it will stretch-form metal up to an area of 2 1/2 square inches.

An entirely new rack and gear principle is employed in this machine to provide variable stretch control, applying stretching only at those points where it is needed. The machine, which receives its power from an accurately controlled hydraulic mechanism, can be set up for completely automatic operation. A pull is permitted up to the ultimate limit of the part being stretched, without overstretching due to improper manual control and without scrap loss.

The new roller-table bending machine consists of a stationary chuck table; a heavy rack and direct-connected hydraulic cylinder; and a table gear which meshes with the rack and on which the dies are mounted. The rack exerts a stretching load against the table gear as it rolls, with its hydraulically actuated carriage, toward the chuck table. When a pre-set pressure is reached, the rack is free to be pulled through the gear, and at that point, the table will travel in a straight line instead of in a rotary path. The rack again starts to travel when the contour of the dies changes, so that a constant stretching load is maintained, regardless of the shape of the part to be formed.



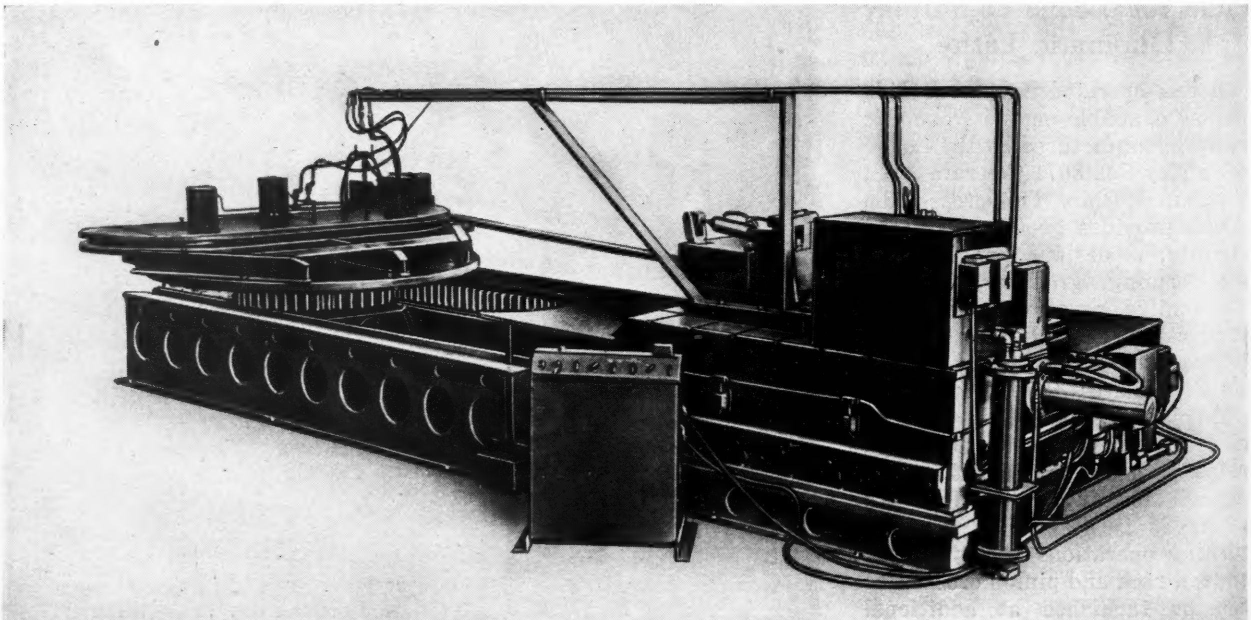
Sundstrand magnetic coolant separator that can be installed in open type coolant tanks

Sundstrand Magnetic Coolant Separator

The new magnetic coolant separator being produced by the Sundstrand Machine Tool Co., 2530 Eleventh St., Rockford, Ill., is designed for installation on many types of grinding, honing, and gear-shaving machines. It is completely automatic, and its simple construction keeps maintenance at a minimum. Longer wheel or tool life, better finishes, less "down" time, and fewer rejections are advantages said to result from the use of this equipment.

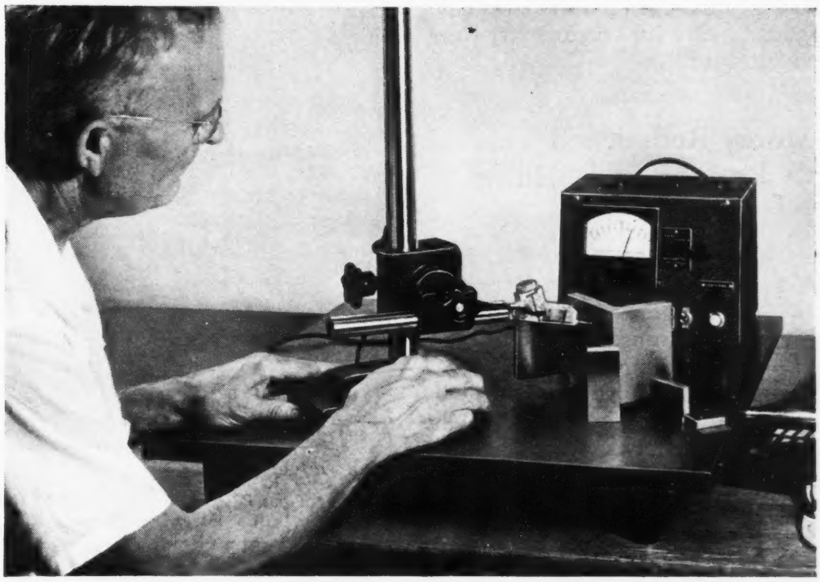
This separator cleans the coolant as the liquid passes under a revolving drum of solid Alnico, which is permanently charged. The coolant is directly exposed to the magnetic drum without interference from non-magnetic insulators. Separated material is removed from the drum by a scraper and deposited in a receptacle, as seen in the illustration.

This new easily installed unit can often be placed directly on top of the machine coolant tank, as shown in the illustration. In this position, it requires little or no additional floor space or piping. The over-all length, including the receptacle for separated material, is 28 inches; the height, 23 inches; and the width 10 1/4 inches.



Roller-table bending machine employing a new rack and gear principle to provide variable stretch control

Electronic Indicator for Shop and Tool-Room Use



Graham-Mintel "Indi-Ac" electronic indicator

The Graham-Mintel Instrument Co., 735 Carnegie Ave., Cleveland 15, Ohio, has announced a new portable, high-precision "Indi-Ac" electronic indicator, designed for checking set-ups and run-outs on machines and for surface-plate gaging and inspection work.

This instrument has an induction type gage head, adjustably mounted on a stand, and a high-stability four-tube amplifier with a two-scale meter. The two continuous linear scales read to 0.0005 and 0.00005 inch or 0.0001 and 0.00001 inch per division either side of zero. Readings are not affected by ordinary changes in temperature of the gage head or fluctuations in line voltage, thus making possible consistent "repeat" readings at all times.

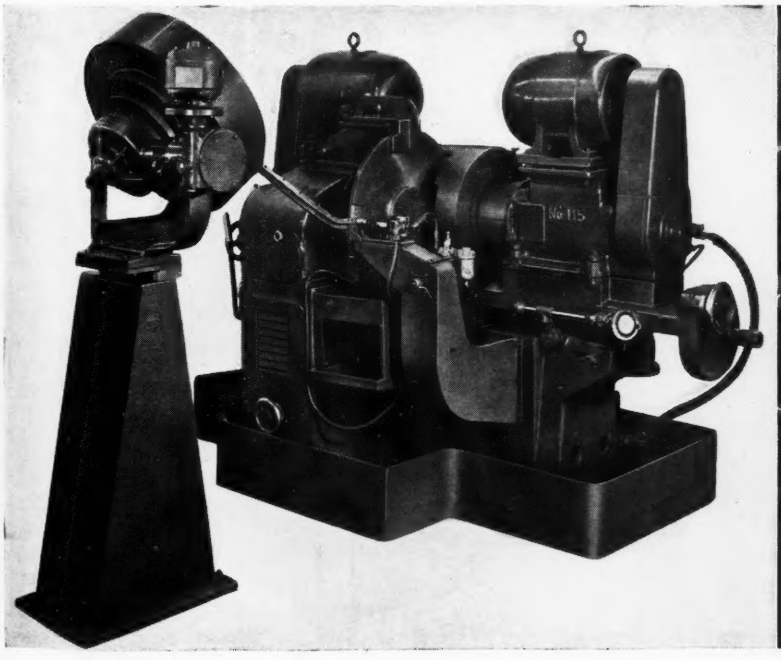
The new indicator is light in weight, sturdily built, and can be used wherever alternating current is available for the amplifier. The gage head can be used with the contact tip at any height from 0 to 24 inches above the surface on which the stand is placed, and (with the support bar horizontal) at any distance between 4 and 10 inches from the front of the base.

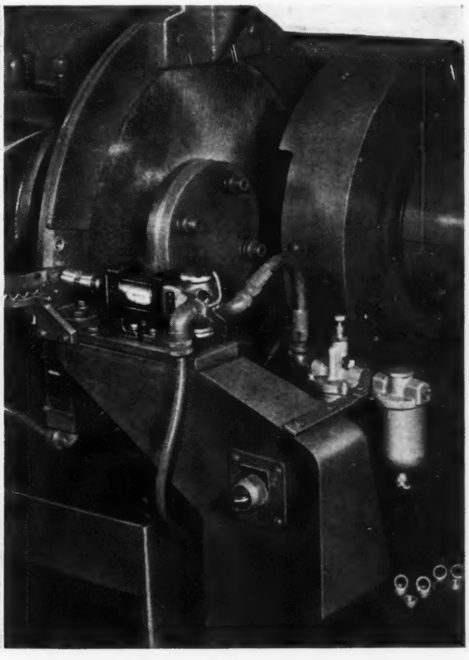
To facilitate set-up, the saddle on the column is adjusted vertically by a rack and pinion.

Gardner Double-Spindle Grinder with Automatic Feed

The Gardner Machine Co., 414 Gardner St., Beloit, Wis., has developed a double-spindle machine for grinding both flat surfaces of carburetor valve seats in one operation. The head slides move on ball-bearing ways on the cast-iron base of the machine, and the heads can be pivoted so that the abrasive discs can be set at the best grinding angle. The abrasive discs are 18 inches in diameter, and are carried on precision spindles.

A rotary work-carrier brings the small parts between the abrasive discs. The hopper shown feeds the parts down a chute to a pneumatic transfer device which rapidly snaps them into the rotating carrier. The valve seats are automatically ejected after grinding. The average production rate is forty to fifty pieces per minute, removing 0.006 inch of stock. Tol-





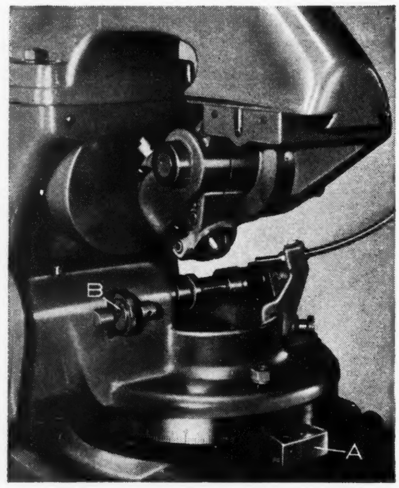
Gardner double-spindle machine with automatic feed for grinding both flat surfaces of carburetor valve seats

erances of 0.0005 inch for flatness, 0.001 inch for parallelism, and 0.001 inch for uniformity are maintained.

Morey Redesigned Vertical Profiler and Milling Machine

The Morey Machinery Co., Inc., 406 Broome St., New York 13, N. Y., has announced that its high-speed, vertical profiler and milling machine has been redesigned. The new machine is equipped with improved spindle bearings, and has splined shafts in place of keyways. The splined construction is also applied to the spindle. There are hardened and ground steel ways on the cross-slide, and the travel head is mounted on rollers which ride on ball bearings to eliminate friction and assure quick, easy movement.

The gear train of this machine has been simplified, and the control handle relocated for easier operation. Standard equipment now includes a slotted table, table and cross-slide stops, a draw-bar, and collet. The profiler is available in the double spindle type.



Newly improved gear-hobber for generating small precision gears

Hamilton Hobber of Improved Design

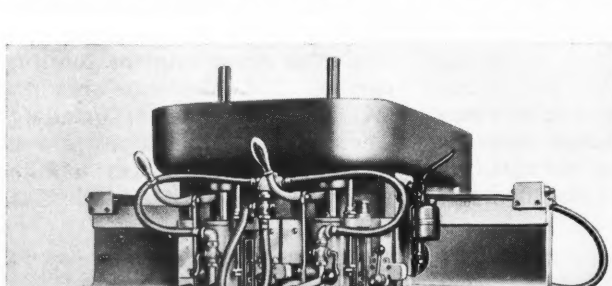
Two improved features have recently been incorporated in the No. 1 gear-hobber manufactured by the Hamilton Tool Co., 834 S. Ninth St., Hamilton, Ohio, for the generation of small precision gears. One is a vernier (shown at *A* in the illustration), by means of which the degree graduations on the turntable scale can be read to minutes. The second is a knurled thumbwheel *B* which provides an accurate and rapid means of positioning the hob relative to the work-piece.

In addition, Ruthman gusher pumps are now used on this machine for the circulation of coolant, and the coolant system is operated through controls independently of other working parts.

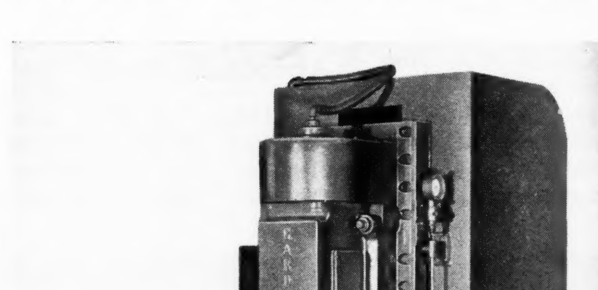
Gardner Double-Spindle Grinder for Thin Parts

Equipment for the precision grinding of both sides of thin flat parts in one operation has been developed by the Gardner Machine Co., 414 Gardner St., Beloit, Wis. The new double vertical surface grinder, here illustrated, while shown set up for grinding small ceramic parts, is adapted for a wide variety of parallel grinding.

The vertical column, mounted on a sub-base, is provided with ball-bearing ways on which the two grinding head slides move. The heads can be tilted, allowing the 23-inch diameter abrasive



Morey redesigned profiler and milling machine



Gardner grinder for finishing both sides of flat parts

discs to be set to the angle required for best grinding results. The head movement is controlled by handwheels located on the side of the column, and a handwheel also actuates the dresser.

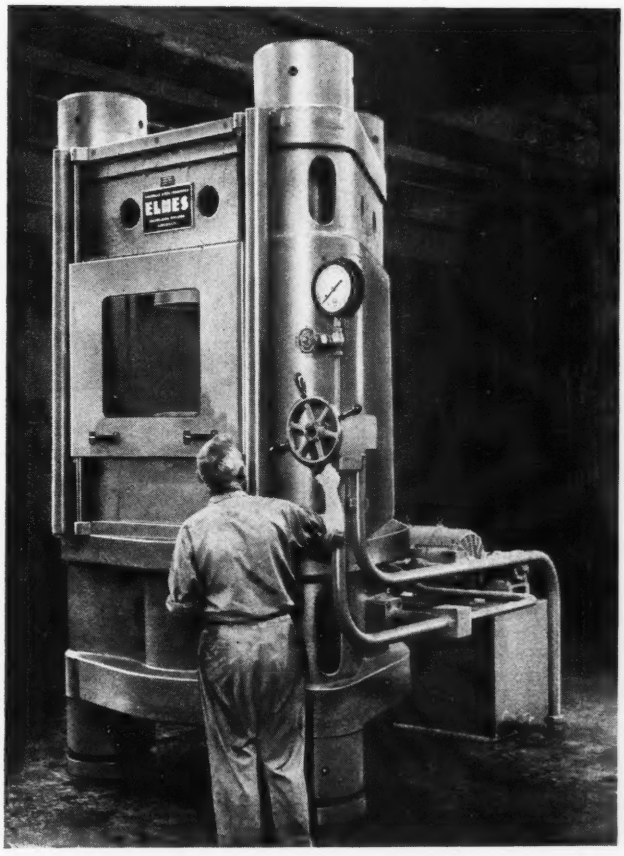
The power-driven rotary work-carrier is located on the front of the sub-base. Guides are provided to locate the work-pieces properly as they enter between the abrasive discs, and to keep them properly located when leaving. Parts are loaded by hand into the rotating carrier, and unloaded automatically by the action of gravity.

Elmes Hydraulic Hobbing Press for Aircraft Engine Production

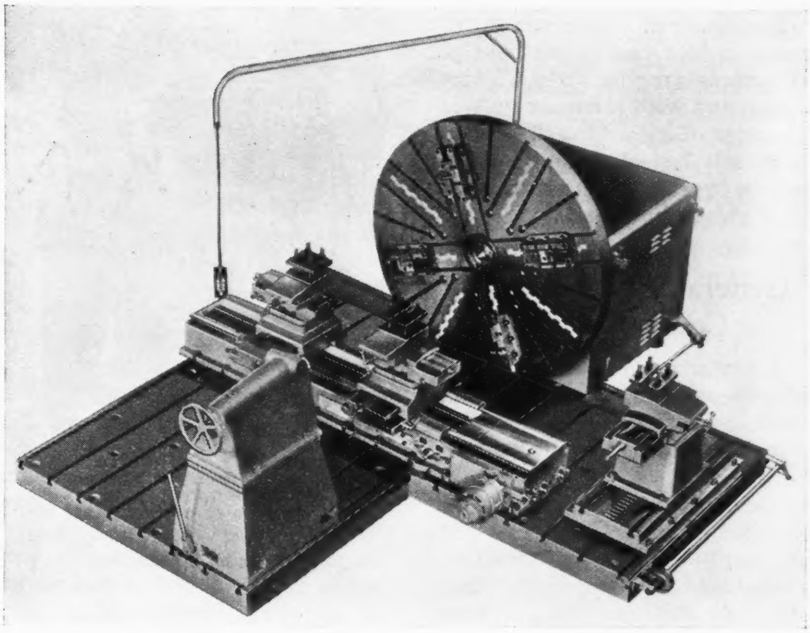
The 2500-ton hydraulic hobbing press here illustrated is one of several recently built by the Elmes Engineering Division of American Steel Foundries, 1162 Tennessee Ave., Cincinnati 29, Ohio, for a manufacturer of aircraft gas turbine engines and accessories.

Ordinarily, hobbing presses are used for sinking impressions into blocks of prepared steel to form duplicate die inserts, multiple-cavity molds, and single molds with intricate contours. The new presses, however, have an unusual application. They will be used primarily for quenching operations. This involves quick cooling of hot forgings while they are restrained in a die under extremely high pressure, thereby maintaining maximum accuracy.

The principal specifications of this press are as follows: The distance between the columns from left to right is 39 inches, and the maximum opening between the platen and the head is 32 inches. The press has a stroke of 15 inches, with a speed of 10 inches per minute for the advance; 1/2 inch per minute for pressing; and 20 inches per minute for the return. The over-all height is 10 feet 8 inches, and the weight 50,000 pounds.



Elmes hydraulic hobbing press used for quenching operations in the production of aircraft engines


Largest model of the sectionalized T-lathes placed on the United States market by Kurt Orban Co., Inc.

Sectionalized T-Lathes for Turning and Facing Large Pieces

Sectionalized T-lathes manufactured by Heyligenstaedt & Co., Germany, and placed on the market in the United States by Kurt Orban Co., Inc., 21 West St., New York 6, N. Y., are specifically designed for handling large pieces, and are equally adaptable to turning or facing jobs. By using standardized lathe units, it is possible to assemble complete machines for a wide variety of requirements.

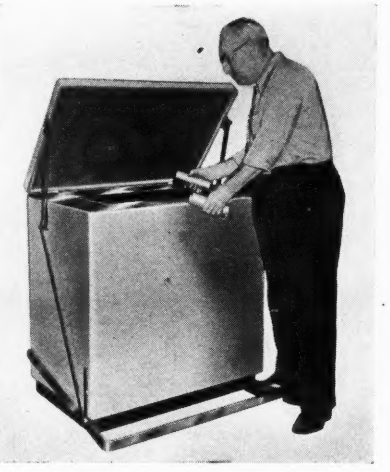
A unique feature of these lathes is the synchronous motor feed. A pilot motor on the headstock is electrically connected to a servo motor on the saddle. This method of feed eliminates the need for mechanical transmissions that limit effective turning length. The cross bed and rear toolpost pedestal can be adjusted to any desired position on the baseplate. For example, these members can be located in a transverse position for facing cuts or in a longitudinal position for end turning. In the latter case, a secondary bed, with saddle and toolpost, is used.

Sectionalized lathe units are made in four models, with height of centers ranging from 37 to 47 inches and with a maximum work diameter of 235 inches. The smaller models have infinitely variable spindle speeds and the larger models eighteen speeds.

General Electric Motor Control Center

A motor control center for use wherever two or more alternating-current motors (up to 200 H.P., 600 volts) are controlled from a central location has been announced by the General Electric Co., Schenectady 5, N. Y. The new center, completely wired and assembled and employing many standard components and accessories, was developed for use in paper mills, chemical, petroleum, steel, rubber, ore, and other processing plants, as well as in power stations and public buildings.

This center provides a simplified method of installing and servicing, in a central location, alternating-current combination motor starters in NEMA sizes 1 through 5, as well as lighting panels and associated equipment for a group of motors. It is designed to withstand short circuit stresses up to 25,000 amperes.



New low-temperature cabinet for rivet cooling, shrink-fitting, and other industrial uses

Low-Temperature Cabinet for Industrial Use

A new low-temperature cabinet designed for industrial use has been introduced by the Brewer-Titchener Corporation, Binghamton, N. Y. Known as the "Rigid-Frigid," it produces sub-zero temperatures as low as minus 40 degrees F. This equipment can be used for rivet cooling, shrink-fit assembly, size stabilization of metal, storing punched and formed aluminum alloy parts, applying sub-zero cooled compressed air to metal-cutting tools, and treating hardened steels.

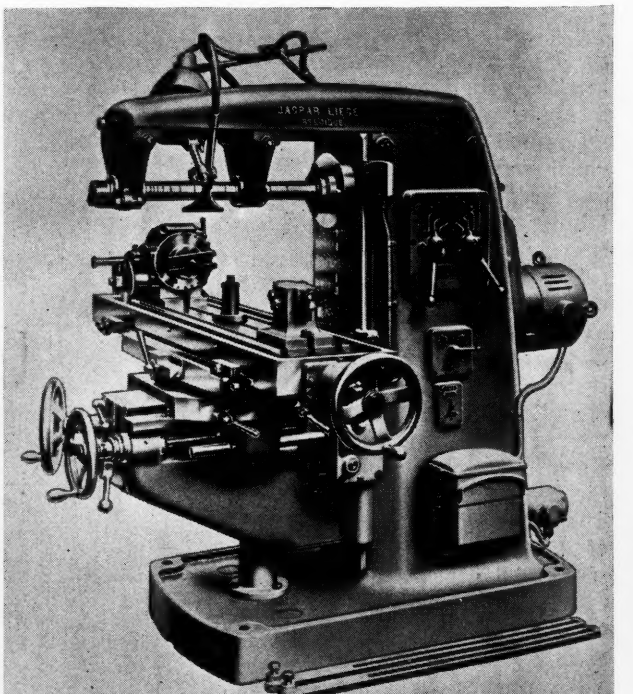
The cabinet is 40 inches long by 36 inches high by 32 inches wide, and has 2 1/2 cubic feet of refrigerated storage space. It is provided with a foot-treadle which opens the lid and leaves both of the operator's hands free for handling frozen parts or materials. The cabinet is powered by a 1/3-H.P., 110-volt, alternating-current motor.

Jaspar Milling Machines

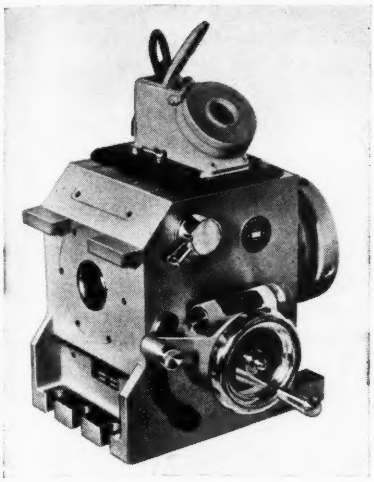
The Jaspar line of milling machines, built in Liege, Belgium, is now available in the United States through the Morey Machinery Co., Inc., 406 Broome St., New York 13, N. Y. These milling machines are made in both vertical and universal types and in two sizes. In most instances, the universal type has been especially designed to provide for the application of climb-milling attachments.

The machines are sturdily built, so that the maximum speeds of tungsten-carbide cutters can be utilized in production manufacturing. The spindle is motor-driven, and a separate driving motor is provided for actuating the table feeds.

Motor control center for alternating-current motor starters, lighting panels, etc.



Jaspar milling machine placed on the market in this country by the Morey Machinery Co., Inc.



Griswold optical dividing head for inspection and production measuring

Griswold Optical Dividing Head with Fixed Base

A dividing head with a fixed base has been developed by the F. T. Griswold Mfg. Co., 305 W. Lancaster Ave., Wayne, Pa. This equipment is designed for use in inspection applications and as a production tool for checking angular dimensions, such as the spacing of spur gear and ratchet teeth, measuring eccentricity and contours of cams and other shapes, and checking the accuracy of milling cutters, broaches, splined shafts, etc. It can also be used on machine tools where precise positioning is required in either a horizontal or a vertical plane.

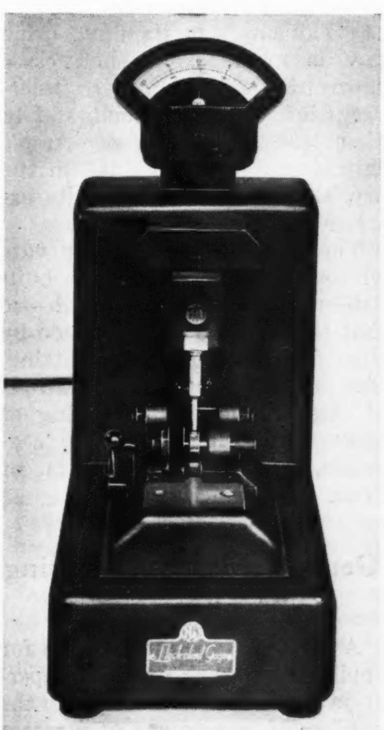
Measurements are made optically by the alignment of visible scales; thus accuracy is independent of mechanical wear and other conditions that vary with temperature and use. Also, any one of a series of measurements can be reproduced, regardless of the direction of spindle rotation. In some inspection applications this is very important.

The optical system consists of a circular dial marked in thirty second divisions, and an illuminated glass scale on which degree marks from 0 to 360 are etched. These degree marks are projected on a ground glass screen and aligned between two reference marks on the screen. Readings are made at normal eye level, and the measurements are read directly on a large scale. Measurements made on the periphery of a 12-inch circle can be held within 0.0005 inch on the chordal distance.

P & W Gage for Measuring Radial Play of Ball Bearings

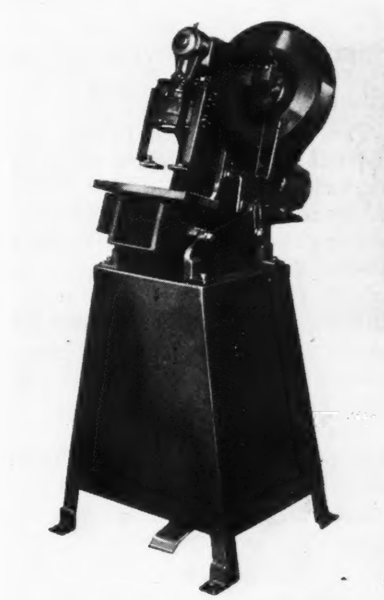
A comparator for measuring the radial play of ball bearings has been developed by Pratt & Whitney Division of Niles-Bement-Pond Co., West Hartford 1, Conn., in cooperation with the New Departure Division of General Motors Corporation. This "Electrolimit" internal clearance comparator is intended for gaging small precision instrument type bearings. With interchangeable tooling, it will handle bearings with bore diameters ranging from 3/32 to 1/2 inch.

The principal part of this lever type comparator is the C-shaped sub-assembly, which has an arbor that securely holds the bearing in a vertical position by its inner ring, so that the outer ring is free to move according to the amount of radial play. An "Electrolimit" gage head, attached to the upper portion of the C-frame, has a diamond-tipped gaging spindle which bears against the top of the outer bearing ring. This presses the outer ring down, with all clearance at the bottom and it is at this point that the first of two comparative readings is taken.



Gage for measuring radial play of ball bearings developed by Pratt & Whitney

To obtain the second reading, the entire C-frame is tilted downward on pivots which support it over a sub-base. The bottom of the outer ring then contacts the stationary anvil. This presses the outer ring upward on the arbor, so that all clearance is at the top. Here a second reading is taken. The difference between the two readings represents the amount of radial clearance in the bearing.



New inclinable open-back punch press of 5 tons capacity

Whitney Inclinable Punch Press

A small, powerful inclinable punch press has been added to the line of the Whitney Metal Tool Co., Rockford, Ill. This is an open-back machine, which can be tilted to a maximum of 25 degrees. The flywheel of the press is at the rear instead of at the side as in conventional design. This location of the flywheel provides greater safety, and gives more "elbow room" when feeding stock into the press.

The new No. 127 press is rated at 275 strokes per minute, and has a capacity of 5 tons. It is provided with a positive "non-repeat" clutch, which, if desired, can be released for automatic feed. The throat is 6 inches deep and 7 inches high. The length of stroke is 1 inch with a stroke adjustment of 1 1/4 inches. The die space is 5 3/4 inches, with stroke down and adjustment up.

Portable oven with eight sliding drawers, made by Grieve-Hendry Co.

Portable Oven with Eight Sliding Drawers

The latest addition to the line of portable electric ovens made by the Grieve-Hendry Co., Inc., 1101 N. Paulina St., Chicago 22, Ill., has eight drawers that permit several different materials to be baked at the same time or materials to be inserted at various intervals. High-temperature magnesium strip heaters provide efficient heating.

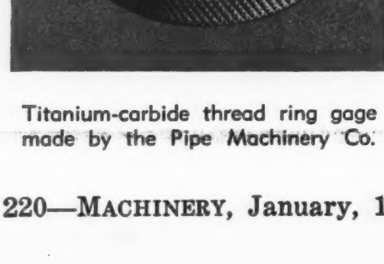
The oven weighs only 118 pounds, and is easy to move. Temperature control is by thermostat, and is adjustable up to 325 degrees F. The oven can be plugged into a 110-volt outlet. Forced circulation is provided by a fan.

The ovens can be equipped with an outside reading thermometer; a sixty-minute, six-hour, or twelve-hour timer; a red pilot light; and an exhaust chamber adapter. The outside dimensions are 30 inches wide by 25 inches deep by 24 inches high.

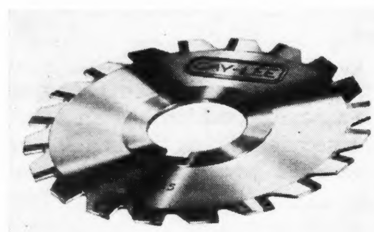
Titanium-Carbide Thread Ring Gage

Thread ring gages made of a new material known as "Demark" (a combination of titanium and carbide) are being produced by the Pipe Machinery Co., 907 E. 70th St., Cleveland, Ohio. These gages are light in weight, and have unusually long wear life. A special wear check plug gage is provided with each ring. This gage is a double-end type, with one end made slightly larger to detect any possible wear in the ring gage.

Every gage is registered with a serial number engraved on it, the lead, angle, diameter, and hardness being recorded and filed under that number.



Titanium-carbide thread ring gage made by the Pipe Machinery Co.



Carbide-tipped saw, 0.030 inch thick, developed for precision slitting

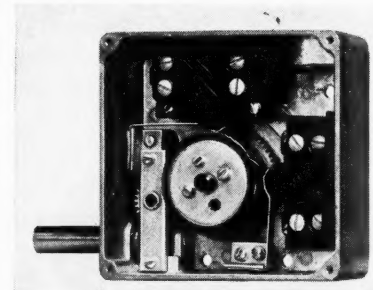
Thin Carbide-Tipped Slitting Saw

For extreme precision slitting, the Gay-Lee Co., 71 W. 14-Mile Road, Clawson, Mich., has added a new carbide-tipped saw, known as "Thinsaw," to its line. This saw is available in thicknesses down to 0.030 inch, with tolerances held to 0.0002 inch, and in diameters up to 5 inches. Ample chip clearance is provided in the new saw, notwithstanding its extreme thinness.

These saws produce deep cuts without run-out, and can be built flat—with no protruding hub—so that they can be lined up side by side for close multiple cutting. One of the successful applications of this tool is in the cutting of business-machine type-bar segments, where alignment is of great importance.

General Electric Rotating Type Limit Switch

A rotating type limit switch for application where reversing operation is to be coordinated with the number of revolutions of a motor shaft or driven equipment has been developed by the General Electric Co., Schenectady 5, N. Y. Superseding four previous forms, the new switch can be used to control motor-operated doors and windows, valves on machine tools, baling operations, travel limits on machinery, etc.

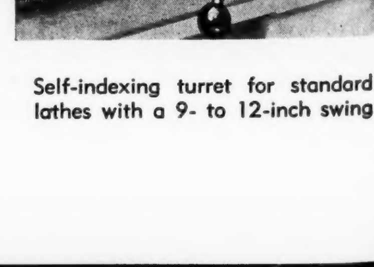


Rotating type limit switch for the control of motor-operated doors, machine tool valves, etc.

The switch consists of two "Switchettes," each having one normally open and one normally closed circuit. The switch units are operated independently by cams rotated through a worm and gear from a shaft extending outside the case. The new switch can be adjusted to operate from 4 to 110 turns of the driving shaft with 5 turns over-travel in either direction, and it is said that unlimited over-travel is possible without damage to the switch. Adjustment is accomplished by simply loosening two clamping screws, turning slotted adjusting pins to the desired setting, and retightening clamping screws.

Globe Self-Indexing Bed Turret

A self-indexing bed turret for use on most standard lathes having a swing of 9 to 12 inches is a new product of Globe Heat-Seal, Inc., 3380 S. Robertson Blvd., Los Angeles 34, Calif. The simple self-indexing mechanism is linked

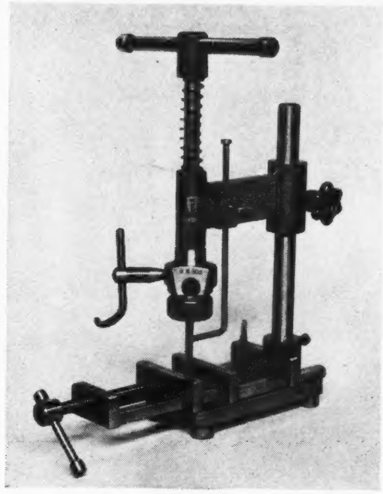


Self-indexing turret for standard lathes with a 9- to 12-inch swing

to automatic stop-rods that limit the length of stroke of the slide, and can be set for any requirement up to the full working stroke of 5 1/4 inches. The total slide travel is 6 inches.

The turret is guided in its rotation by a large-diameter pilot, which engages a mating bearing in the slide. Flat bearing surfaces between the ram and the turret are hand-scraped to a close fit. With this design, the entire work load is applied to the pilot and flat bearing surfaces, resulting in extreme rigidity.

Indexing is performed by a spring-loaded tapered pin sliding in a sleeve and engaging a mating tapered bushing in the turret. The hexagonal turret is provided with flat faces which accommodate flanged tool-holders, and can be bored for straight-shank tools. Long bars can extend completely through the turret.



Bench tapping machine that facilitates manual tapping operations

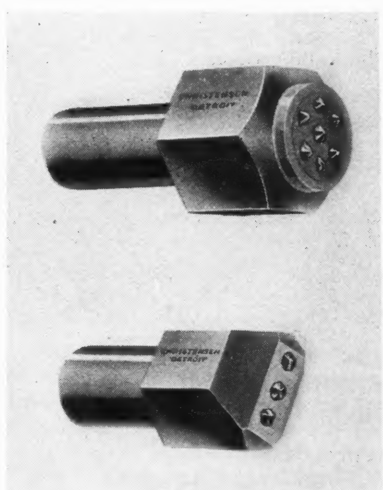
Wesco Bench Hand Tapping Machine

The bench hand tapping machine manufactured by the Wechsler Machine Co., 363 Plane St., Newark 2, N. J., will take any tap from 0-80 to 1/2 inch without the use of collets, the changing of chucks, or any critical adjustments. The chuck which is regularly furnished with the machine is designed to keep the tap accurately centered by the use of three moving jaws, and to grip the squared end of the tap to prevent turning.

This machine speeds hand-tapping and eliminates crossed threads, broken taps, or rejection of work due to threads being tapped off center. It will handle work 3 1/4 inches wide in either square or round stock. The drilled hole can be centered under the tap by one simple adjustment of the vise which is mounted on the base of the machine.

Detroit Standardized Taps for Specific Materials

Taps, each of which is designed and produced for a specific material, are now available from the Detroit Tap & Tool Co., Detroit, Mich. Each tap carries on the shank the designation of the material for which it has been designed, such as "steel," "cast iron," "aluminum," "brass," "zinc," or "plastic." Among the changeable factors which can be varied in the taps to make them suited for specific materials are flute forms, chamfers, and method of heat-treatment.

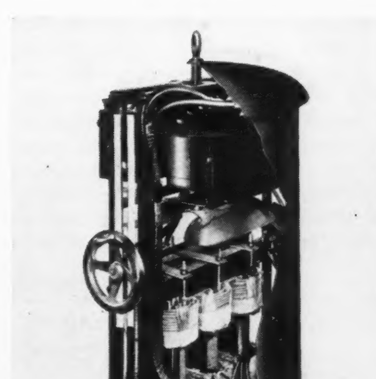


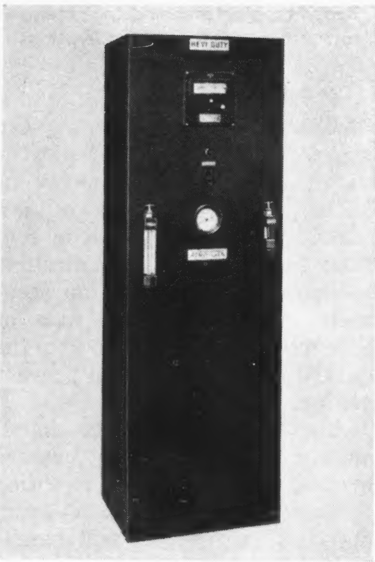
Christensen Wheel-Dressing Tools

Group-mounted and chisel-face wheel-dressing tools recently added to the line of the Christensen Diamond Tool Co., Detroit, Mich. Both types utilize a number of whole diamonds, mounted in a powdered-metal matrix called C-Metal. The group-mounted tools are recommended for large outside-diameter straight-face applications where high finish is required. They contain five, six, or seven diamonds, so arranged that three to five points are in contact with the work at all times. The chisel-face tools have two or three diamonds mounted in a straight line, and are primarily intended for large-diameter, wide-face dressing applications.

Smith Heavy-Duty Direct-Current Welding Machine

New heavy-duty direct-current welding machine placed on the market by the A. O. Smith Corporation, Milwaukee, Wis. This machine is designed for all industrial uses in which direct-current welding is required. Extensive field testing has shown the new unit to be free of stack failure. This results from directing a high velocity down draft of cool air over the rectifier stacks before passing the air through other parts of the machine. Available in 200, 300, and 400 ampere ratings.



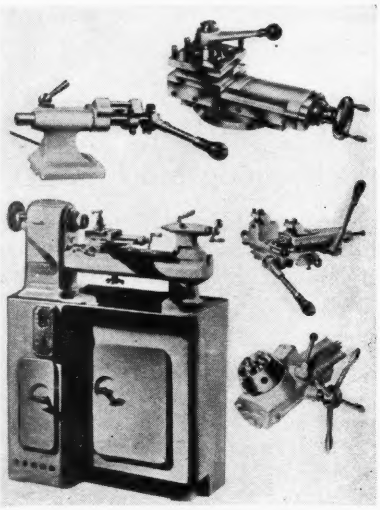


"Atmo-Gen" Atmosphere Generator

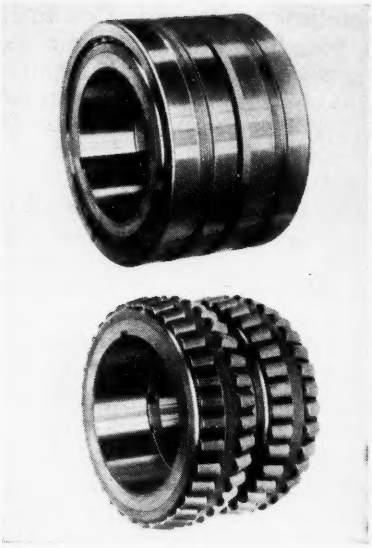
Atmosphere generator, known as "Atmo-Gen," designed to provide atmospheres for the following heat-treating operations: Non-decarburized hardening, dry cyaniding or carbo-nitriding, carburizing, copper and silver brazing, nitriding, sintering, and bright annealing. The unit delivers 150 cubic feet of atmosphere per hour. It consists of an ammonia cracker, housed in a fabricated steel cabinet; electric-tube type furnace with automatic temperature control; catalyst-filled alloy retort; piping; and flow regulation accessories. Placed on the market by Hevi Duty Electric Co., Milwaukee, Wis.

Precision Tool-Room and Production Lathes

Precision lathe of 8-inch swing suitable for both tool-room and production purposes. This lathe can be provided with a wide range of attachments, as shown, for use as a small high-speed turret lathe. All spindles are run in taper roller bearings. Made by Smart & Brown Machine Tools, Ltd., London, England, and sold in the United States by British Industries Corporation, 164 Duane St., New York 13, N. Y. These machines are all designed to take



American collets, are calibrated in inches, and are wired and motorized to meet the requirements of the American NEMA standards.

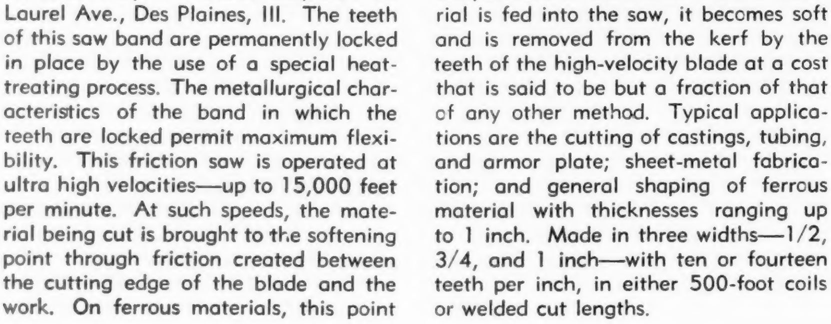


Tyson Full-Roll Tapered Anti-Friction Bearings

Anti-friction bearings designed to handle severe radial and thrust loads. These bearings, made in a new size range, have been added to the standard line of full-roll type tapered anti-friction one-, two-, and four-row bearings produced by the Tyson Bearing Corporation, Massillon, Ohio. Single row bearings are available in outside diameter sizes from 2 to 20 inches; two-row bearings from 4 to 20 inches; and four-row bearings from 6 to 20 inches. These new full-roll units have been designed for use in rod, bar, and strip mills, pinion stands, gear drives, piercing mills, table rolls, reels, straighteners, cranes, and other heavy metal-working machinery.

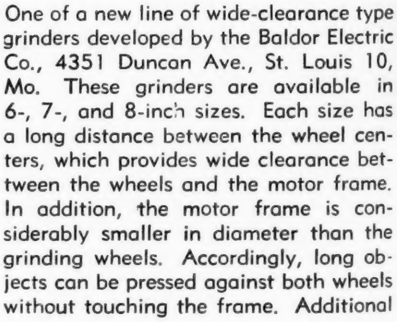
Saw Band for Friction Sawing

Saw band for high-speed friction sawing, introduced by the DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill. The teeth of this saw band are permanently locked in place by the use of a special heat-treating process. The metallurgical characteristics of the band in which the teeth are locked permit maximum flexibility. This friction saw is operated at ultra high velocities—up to 15,000 feet per minute. At such speeds, the material being cut is brought to the softening point through friction created between the cutting edge of the blade and the work. On ferrous materials, this point of plasticity is approximately the forging temperature of the metal. As the material is fed into the saw, it becomes soft and is removed from the kerf by the teeth of the high-velocity blade at a cost that is said to be but a fraction of that of any other method. Typical applications are the cutting of castings, tubing, and armor plate; sheet-metal fabrication; and general shaping of ferrous material with thicknesses ranging up to 1 inch. Made in three widths—1/2, 3/4, and 1 inch—with ten or fourteen teeth per inch, in either 500-foot coils or welded cut lengths.



Baldor Wide-Clearance Grinders

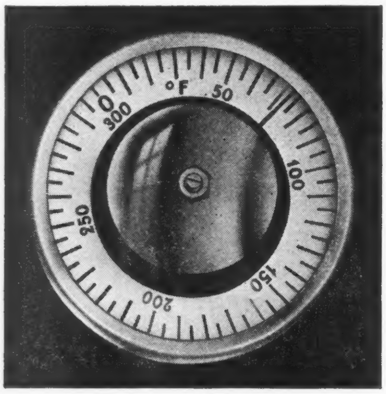
One of a new line of wide-clearance type grinders developed by the Baldor Electric Co., 4351 Duncan Ave., St. Louis 10, Mo. These grinders are available in 6-, 7-, and 8-inch sizes. Each size has a long distance between the wheel centers, which provides wide clearance between the wheels and the motor frame. In addition, the motor frame is considerably smaller in diameter than the grinding wheels. Accordingly, long objects can be pressed against both wheels without touching the frame. Additional



features include ball bearings which require no lubrication during their lifetime; a capacitor type motor in single-phase units that will not burn out under repeated overloads; heavy cast-iron guards, and tool-rests that are adjustable horizontally and vertically, and can also be tilted to permit grinding the work to an angle.

Thermometer for Indicating Surface Temperatures

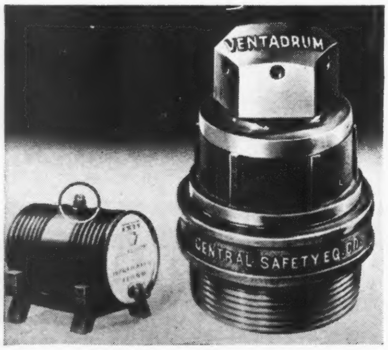
Thermometer for fast, accurate checking of surface temperatures. The instrument can be affixed to any flat surface by silicone grease, or a small magnetic

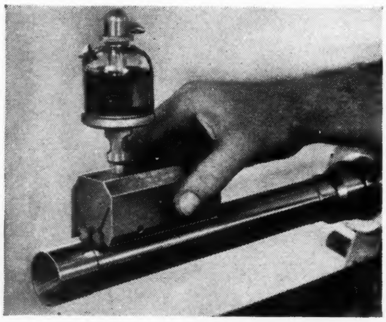


clamp can be used to hold it securely in place on steel dies or other ferrous surfaces. The thermometer has a range of 0 to 300 degrees F., is 2 inches in diameter, and weighs 1 ounce. Announced by the Pacific Transducer Co., 11921 W. Pico Blvd., Los Angeles 64, Calif.

"Ventadrum" Safety Valve for Chemical and Other Drums

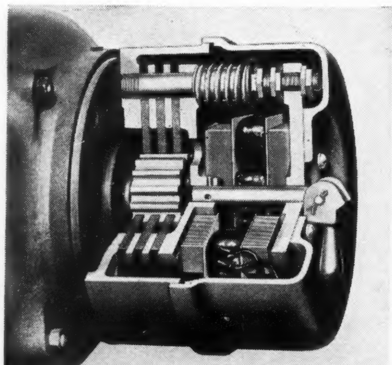
Safety valve designed to control and eliminate dangerous explosions caused by pressure expansions in 50-gallon metal drums. This valve, known as "Ventadrum," is applicable to standard fuel, chemical, and cleansing fluid containers. It is screwed into the bung opening of a universal type 50-gallon drum and functions automatically. Manufactured by the Central Safety Equipment Co., 2201 E. Huntingdon St., Philadelphia 25, Pa.





Universal External Hone for Finishing Cylindrical Surfaces

General-purpose hand tool for reducing and finishing external cylindrical surfaces. Can be used on any metal, for both parallel and tapered surfaces. No special skill is required to produce highly finished surfaces with geometric accuracy on all types of cylindrical and tapered parts, such as tapered shanks, guide pins, pistons, plug gages, etc. Will remove chatter marks and cross pattern rapidly. Accuracy of the work is not affected by stone wear. Work can be chucked in any lathe, drill press, or electric drill. A universal oiler, attached to the hone, has finger tip control to allow coolant to flow from a slow drip to a steady stream. Product of Universal Power Sprayer Co., Plymouth, Mich.

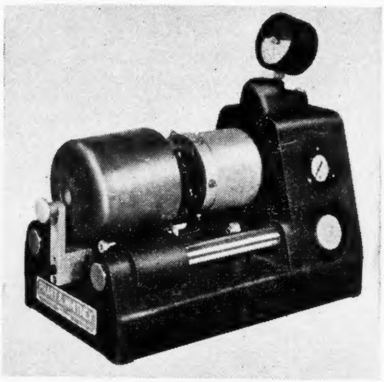


Dings Disc Type Magnetic Brake for Stopping Motors

New alternating- or direct-current disc type magnetic brake introduced by Dings Brakes, Inc., subsidiary of Dings Magnetic Separator Co., Milwaukee, Wis. This direct-acting magnetic brake is designed to stop any motor instantly, hold the load, and release with no drag. The brake is spring engaged and magnetically released, and is designed for mounting on NEMA Type C motor flanges. A lever is also provided for disengaging this brake. Can be used to advantage on machine tools, hoists, cranes, elevators, etc.

P & W Compressor Housing Gage

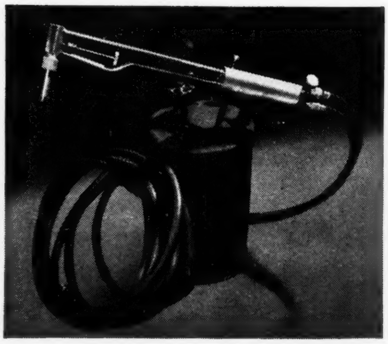
Special Air-O-Limit gaging fixture for checking the bores of refrigerator compressor housings. These housings are of deep-drawn sheet steel, and have an average internal diameter tolerance of 0.002 inch, with a maximum out-of-round tolerance of 0.015 inch. The



gage checks the housing bore for average diameter at several points along the entire length of the internal wall. Developed by Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford 1, Conn.

Cutting Torch that Uses Gasoline as Fuel

Recently developed cutting torch that burns gasoline and oxygen. It operates on the same principle as an acetylene torch, the blended liquid gasoline and oxygen being converted into vapor in the torch tip by the heat of the flame. This torch is said to have many advantages. Made by Browning Torch Corporation, and distributed by Steel News Industries, Inc., R. D. No. 2, Canonsburg, Pa.



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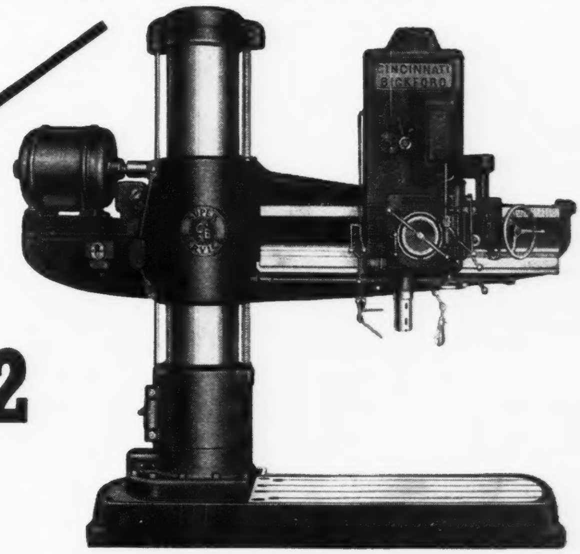
Write for literature on machines of interest to you.

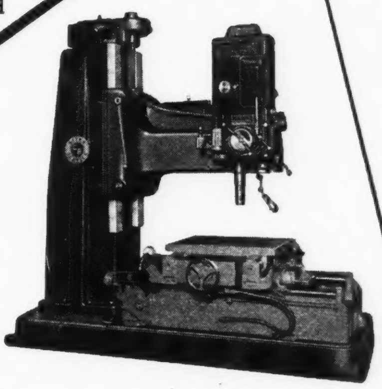
1

The 9″ Diameter Column SUPER SERVICE Radial Drill, described in Circular R-21B, is built in either a 3′ or 4′ arm length with 9 speeds and 4 feeds powered with a 3 HP driving motor.



2

The 36-speed 18-feed SUPER SERVICE Radial Drill, described in Booklet R-29, is furnished in 11 different standard sizes, ranging from 3′ to 8′ arm lengths and 11″ to 19″ diameter columns. Machines are furnished with 7½ to 20 HP driving motors.

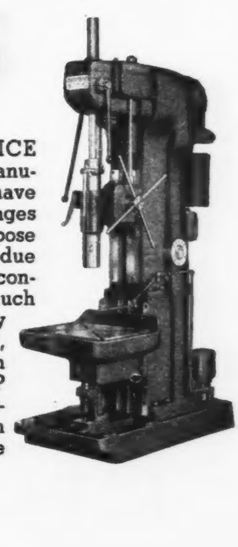


3

The new SUPER SERVICE Precision Drilling Machine is especially suited to operations in conjunction with an automatic spacing table. This 36-speed, 18-feed, 10 HP motor machine is more completely described in Circular FH.

4

The SUPER SERVICE General Purpose Upright Drilling Machines, as described in Booklet U-25-A, are furnished in 21″, 24″ and 28″ sizes. From 9 to 12 speeds and 4 to 9 feeds. The machines are powered by either 3, 5, or 7½ HP motors.



5

The SUPER SERVICE High Production Manufacturing Uprights have many of the advantages of the general purpose drilling machines but, due to their simplified construction, they are much more economical. They are furnished in 21″, 24″ and 28″ sizes with 3, 5, 7½ or 10 HP driving motors. Booklet U-27 will furnish you more complete details.

RADIAL AND UPRIGHT SUPER C B SERVICE DRILLING MACHINES

THE CINCINNATI BICKFORD TOOL CO. Cincinnati 9, Ohio U.S.A.

Air-Operated Index-Table

New air-operated index-table for light milling, drilling, tapping, and similar operations. Manufactured by "Web-Aire" Products Division, H. G. Weber & Co., Inc., Kiel, Wis. The table is mounted on large ball bearings with hardened steel stops. All moving parts are enclosed.

* * *

Machining Tungsten Metal

A new technique for drilling, grinding, turning, milling, threading, and tapping tungsten metals has been developed by Philips Laboratories, Inc., Irvington, N. Y. It is claimed that the process enables tungsten metal to be machined within tolerances comparable to those normally maintained in cutting steel or brass.

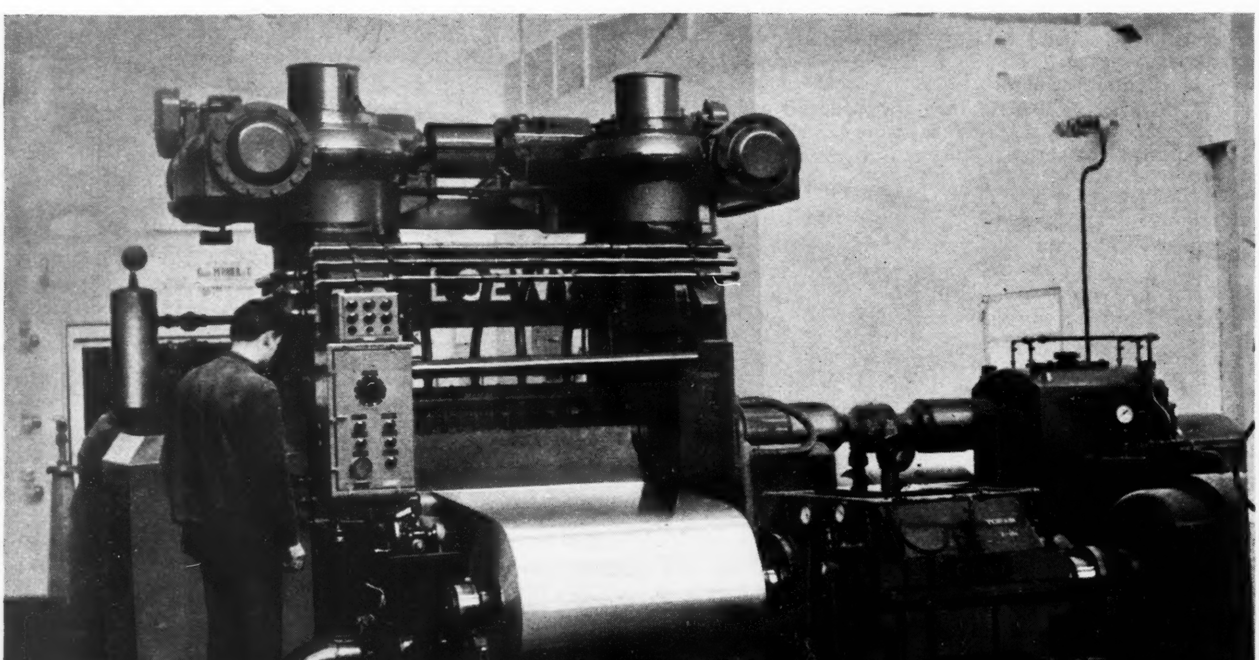
High-Speed Cold-Rolling Mills for Aluminum Strip and Foil

The Loewy Rolling Mill Division of Hydropress, Inc., New York City, recently placed in operation two high-speed installations for the rolling of aluminum foil 42 inches wide by 0.00025 inch thick. Each of these installations is composed of one four-high roughing mill, 10 and 24 inches by 48 inches, and one two-high finishing mill, 18 by 48 inches, with their accessories. These mills are capable of producing foil at speeds up to 3000 feet per minute. Provided with mechanical and electrical equipment that assures accurate control of gage and trouble-free operation, they can be operated with a minimum of skilled personnel.

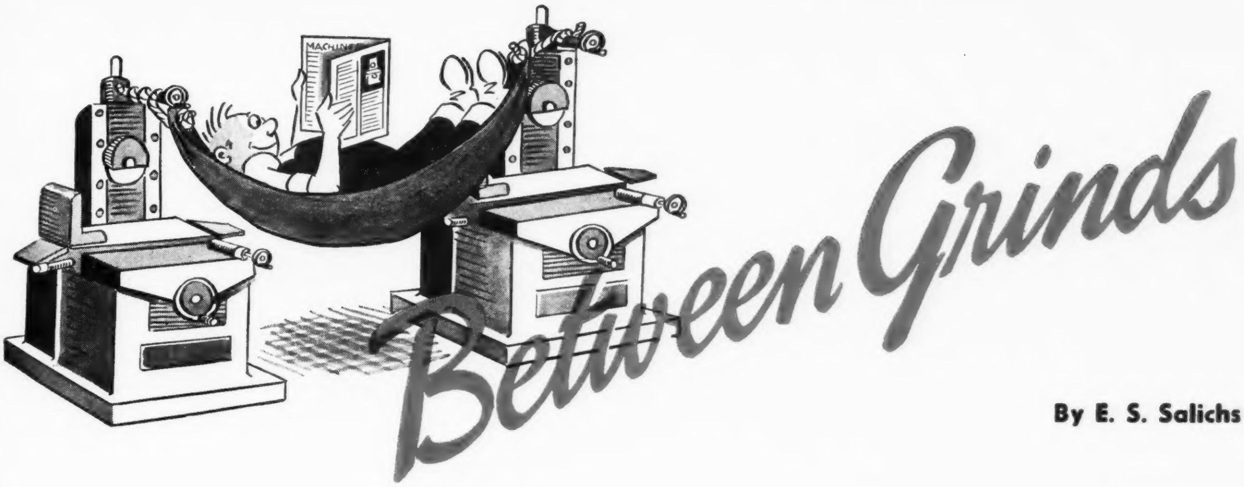
The push-button station is located close to the mill on the delivery side, permitting the operator to observe closely the product he is rolling; from there he also controls the screwdowns—either in unison or separately—the front and back tension, and the speed of rolling, according to the thickness of the material leaving the mill, as indicated by his electric gage. The electrical equipment enables the operator to accelerate or decelerate the mill steplessly at any pre-set rate, and allows him to maintain a predetermined front and back tension during acceleration and deceleration while the mill is running or standing still.

The mill housings are of sturdy construction, with large post sections to maintain the gage accurately. Bearings for the back-up rolls of the four-high mill, as well as for the rolls of the two-high mill, are of the constant-temperature oil-film type, assuring trouble-free operation and eliminating danger of off-gage material due to overheating when running at high speed. The working rolls, of special forged chromium alloy steel, are provided with internal cooling means, and the chocks are hydraulically balanced. Adjustable spraying and wiping devices for the rolls permit accurate control of roll temperature and crown.

The coils weigh up to 3000 pounds. They are loaded on the winding or unwinding reels by means of carriages controlled by the operator from the push-button station. The unwinding reels are provided with a device that permits the drum to be moved axially to correct telescoping of the coil.



A two high finishing mill recently placed in operation by the Loewy Rolling Mill Division of Hydropress, Inc., for rolling aluminum foil 42 inches wide by 0.00025 inch thick



By E. S. Salichs

Vexatious Visitor?

CMP (Controlled Materials Plan) in Washington was surprised one morning before the holidays to find a new interpretation of its initials by a wishful thinker who had written in large letters on the building front:

Christmas
Minus
Priorities

Top Mag on the Totem Pole

A subscriber of nine-years' standing told us his subscription was for life, and added "Without MACHINERY I would not be an engineer. I only had elementary school training."

Bombs and Bases Loaded

Pictures of machining operations at the Atomic Energy plant in Oak Ridge, Tenn., for use in an article to appear in MACHINERY, were naturally examined carefully by the Editor before sending them in to the retouching department—even to the point of reading World Series baseball scores posted on a wall in the background of the pictures.

Whose Pickle?

A news release came to us containing a typographical error which resulted in a discussion of a dill slotter about to be introduced on the market.

It's Only a Plastic Moon

In a research program known as Moby Dick (a whale of a job?), the Air Force has been releasing systematically large transparent plastic balloons, 110 feet in diameter and 130 feet long, in order to study high altitude winds over the United States. The balloons are equipped with transmitters that send signals to Air Force stations, and are visible on clear days at 100,000 feet, appearing like small moons. If, while outdoors, you should suddenly be swamped by some collapsed material, the Air Force urges you, upon disentangling yourself, to return the transmitter and keep the plastic cover.

How Not To Series

Take a child's rubber ball (bully), chill it to —100 degrees F. in dry ice. Bounce the ball and it will shatter just as the Christmas tree ornament did that slipped out of your hand as you were reaching to trim the top branch, side center.

Tum Address

Our order department was recently directed to send a copy of MACHINERY'S HANDBOOK to a purchaser at the Tum Tum Trailer Court, Amboy, Wash.

Capitol Corner

Eastern Machine Screw Corporation of New Haven, Conn., is located on Truman and Barclay Streets.

PIONEER IN PLASTIC — P. LeRoy Venable, author of this month's article on technique in producing plastic tooling for aricraft parts (page 156), is supervisor of the plaster shop and foundry at Northrop Aircraft, Inc., Hawthorne, Calif. Mr. Venable is a native of Clearfield, Utah, which wasn't far enough west for a young man; so in 1930, he journeyed on to Southern California and saw his opportunity in the aircraft manufacturing industry,

first with Douglas, then Vultee. Ten years ago he joined Northrop as this company started to employ plastic dies, and participated in developing processes now adopted as standard procedure in phenolic die fabrication. His business is also his hobby—in a home laboratory Mr. Venable does research on phenolic plastics. He doesn't send a sample of Saturday's baking over to the neighbors though—he saves the batch for the office crowd.

News OF THE INDUSTRY

California

Black & Decker Mfg. Co., Towson, Md., manufacturer of portable electric tools, has moved its Los Angeles, Calif., sales and service branch into a new building at 2432 S. Broadway. The new quarters provide greatly expanded service repair and stock-room space, in addition to a modern showroom. Waldo E. Bair is the branch manager, and R. A. Lomas, service engineer.

Carl E. Swift, 1423 S. Santa Fe Ave., Los Angeles, Calif., has been appointed distributor for the line of metal-cutting tools and special tools manufactured by the Falcon Tool Co., Detroit, Mich.

Illinois

Charles H. Besly & Co. has changed its corporate name to Besly-Welles Corporation, effective January 1. No changes in personnel or production facilities are involved. This move recognizes a sixty-five year association of the Welles family with the organization. E. K. Welles, president, announces that the company's operations will be concentrated on its manufactured products — Besly taps and grinders — and its specialties — Besly drills and reamers and Besly-Titan abrasive wheels. The Besly-Welles executive headquarters and Besly-Titan abrasives sales offices will be established at 20 N. Wacker Drive, Chicago. The Besly-Welles Cutting Tool Division will have its office and local stocks at 184 N. Wacker Drive. National sales will be handled directly from the company's plant at Beloit, Wis.

Charles H. Besly & Co., (now known as the Besly-Welles Corporation), Chicago, Ill., manufacturer of grinders and taps, is transferring its Industrial Supply Division to the Barrett-Christie Co., also of Chicago, in order to concentrate on manufactured products. The Barrett-Christie Co. will occupy the former Besly location at 118 N. Clinton St.

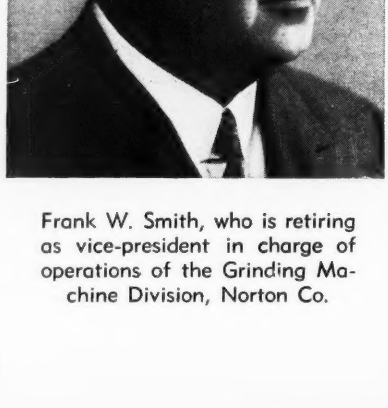
John Waldherr, Jr., has been appointed to the position of director of engineering of the Chefford Master Mfg. Co., Fairfield, Ill. Mr. Waldherr joined the company in 1947, and has served as chief design engineer since 1949. He will direct all engineering activities related to the company's automotive products and ordnance contracts.

Acme Steel Co., Chicago, Ill., manufacturer of specialty strip steel, has announced the formation of the Acme Steel Products Division, which will operate as an independent sales and distributing company for steel strapping, tools and accessories, and other strip steel products. The president of the new division will be John G. Bucuss, formerly general manager of the strapping division.

Indiana Metal Products Corporation, Rochester, Ind., has been licensed to manufacture and sell Shakeproof thread cutting screw types Nos. 1, 23, and 25, which are furnished in Phillips, clutch, slotted, and hex-head types. The sales department of the company is located in the Palmolive Bldg., 919 N. Michigan Ave., Chicago, Ill., and is headed by Frank Campbell.

Henri Barre, works manager of the Chefford Master Mfg. Co., Inc., Fairfield, Ill., has been elected vice-president in charge of production. Prior to joining the company in 1947, Mr. Barre was associated with the Pratt & Whitney Aircraft Corporation for a period of seventeen years.

Edward K. Vaughan has been transferred from the Chicago staff of the New Jersey Zinc Sales Co. to the headquarters office in New York City, and Robert L. Campbell, formerly with the Pigment Division at Chicago, will replace Mr. Vaughan in the Metal Division.



Frank W. Smith, who is retiring as vice-president in charge of operations of the Grinding Machine Division, Norton Co.

Norman B. Weinke, sales manager of the Cullman Wheel Co., Chicago, Ill., manufacturer of sprocket and roller chains, has been elected vice-president of the company. Mr. Weinke will also be in charge of manufacturing.

Bryant Machinery & Engineering Co., Chicago, Ill., has been appointed representative by the V & O Press Co., Division of Emhart Mfg. Co., Hudson, N. Y., for the company's complete line of precision power presses, roll feeds, and "Feed-O-Matics."

Benjamin Sampson, sales manager of the K. H. Huppert Co., Chicago, Ill., manufacturer of electric furnaces and ovens, was recently elected vice-president of the corporation. He will continue to supervise sales.

Hydraulic Press Mfg. Co., Mount Gilead, Ohio, announces that the Chicago office of the company has been moved from 201 N. Wells St., to 3058 Peterson Bldg., Peterson Ave.

Luther & Pedersen, Inc., 565 W. Washington Blvd., Chicago 6, Ill., have been appointed Indiana representatives for the Minster Machine Co., Minster, Ohio, manufacturer of mechanical power presses.

Massachusetts and Connecticut

Frank W. Smith, vice-president in charge of operations at the Grinding Machine Division of the Norton Co., Worcester, Mass., has retired from that position, although he will continue as a consultant responsible for the construction of the company's new $6,000,000 Machine Division expansion. Mr. Smith has been with the Norton Co. for thirty-three years, the last five of which he was a vice-president and director. Everett M. Hicks, manager of the Grinding Machine Division, is assuming Mr. Smith's former responsibilities.

Oscar E. Mason, formerly with the Pratt & Whitney Aircraft Division of Niles-Bement-Pond Co., has been elected vice-president and manager of Associated Engineers, Inc., Aga-

Oscar E. Mason, newly elected vice-president and manager of Associated Engineers, Inc.

wam, Mass. Mr. Mason was associated with Pratt & Whitney Aircraft for twelve years, and at the time of his resignation was executive tool engineer in charge of production engineering operations.

EDWARD A. GREEN has been named manager of product planning in the Small and Medium Motor Department of the General Electric Co., Schenectady, N. Y. Prior to this appointment, Mr. Green was staff assistant to the general sales manager of the company's former Small Apparatus Division in Lynn, Mass., and he will remain at Lynn for the time being.

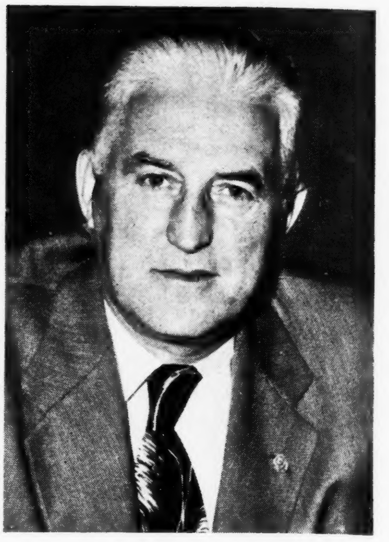
UNIFORM TUBES, Collegeville, Pa., manufacturer of small-diamete seamless tubing, has appointed GRISWOLD & Co., Needham, Mass., representative for the New England states, with the exception of Fairfield County in Connecticut.

J. HENRY ANTHONY, manager of the Industrial Engineering Division of the Whitney Chain Co., Hartford, Conn., has been appointed plant superintendent, in addition to his present duties. Mr. Anthony has been associated with the company in various production capacities for the last twelve years.

Michigan and Minnesota

ARTHUR COLTON CO., Division of Snyder Tool & Engineering Co., Detroit, Mich., announces the following changes in sales personnel: WARREN I. SMITH, who has been connected with the New York office of the Arthur Colton Co. at 303 Fifth Ave. for the last two years in the capacity of sales engineer, is now in charge of the office. THOMAS CASEY and BRUCE WINNER have been added to the New York office sales staff. WILLIAM F. SCHAFER, sales engineer at the New York office for the last eight months, has been made sales representative for the Philadelphia area. GORDON W. COVEY, formerly of the New York office, has been placed in charge of the new Chicago branch office at 5807 W. Diversey Avenue. T. R. COCHRAN, previously assistant sales director at the Detroit office, has been appointed sales representative for the northern California, Oregon, and Washington territory.

REED-PRENTICE CORPORATION, Worcester, Mass., manufacturer of machine tools, die-casting machines, and plastic injection molding presses, has opened a branch sales office at 2842 W. Grand Blvd., Detroit 2, Mich. IVER J. FREEMAN has been named manager of the office.



J. Henry Anthony, new plant superintendent of the Whitney Chain Co.

RALPH W. SPONSELLER, JR., has been appointed a sales representative at the Detroit branch of the Berger Mfg. Division of the Republic Steel Corporation. He will handle the sales of Berger shelving, lockers, office equipment, and special products.

COLONIAL BROACH CO. has just completed an addition to its factory at 21601 Hoover Road, Detroit, Mich., which increases the machine construction area by 30 per cent.

DR. J. O. HENDRICKS has been promoted to the newly created position of associate director of the central research laboratories of the Minnesota Mining & Mfg. Co., St. Paul, Minn.

New Jersey and Pennsylvania

KENNETH W. DONLE has been appointed chief metallurgist of the Tube Reducing Corporation, Wallington, N. J. For the last six years, he held the post of assistant chief metallurgist in the Gary, Ind., plant of the National Tube Co., a subsidiary of the U. S. Steel Corporation.

FERRACUTE MACHINE CO., Bridgeton, N. J., recently appointed the following distributors: FEDERAL MACHINERY SALES CO., 4639 Washington Blvd., Chicago 44, Ill.; ROBERT R. STEPHENS MACHINERY CO., 1706 Olive St., St. Louis 3, Mo.; and E. A. KINSEY CO., 825 N. Capitol St., Indianapolis 4, Ind.

HENRY V. IVORY has been appointed manager of the Elizabeth, N. J., plant of the National Electric Products Corporation, Pittsburgh, Pa. Mr. Ivory

Iver J. Freeman, manager of the recently opened Detroit office of the Reed-Prentice Corporation

came to the newly opened plant from the Picatinny Arsenal, where he was in charge of mobilization planning.

HARRY R. BERKSHIRE has been made representative in greater New York and adjacent territory for the GRAHAM-MINTEL INSTRUMENT CO., Cleveland, Ohio, manufacturer of electronic gaging equipment. His headquarters are at 428 Tenafly Road, Tenafly, N. J.

KENNAMETAL INC., Latrobe, Pa., announces the following appointments: KENNETH TROMBLEY has been assigned to the new Tennessee and Alabama sales district, with headquarters at 18 Clearview Ave., Chattanooga, Tenn.; FRANK PRICE has been appointed engineer and representative in the Middle Atlantic district; and LINDSAY BROS., Portland, Ore., have been named agents covering the western Oregon area.

SPER & CO., 70 E. 45th St., New York 17, N. Y., is a new concern organized by EDWARD A. SPER and ROY SPER to represent manufacturers of etched and stamped metal parts, and screw machine parts. Edward Sper was associated with the Etched Products Corporation of New York City for twenty-five years, and Roy Sper has worked for both Kimball Industries and Vought-Sikorsky Aircraft since World War II.

New York

ONSRUD MACHINE WORKS, INC., Chicago, Ill., manufacturer of high-speed production non-ferrous metal-working and woodworking machinery and equipment, has appointed the BABCOCK MACHINERY CO., 1904 Times Bldg., New York City, representative of the company.

SHERMAN R. LYLE has been appointed district manager of the Steel and Tube Division in the northern Pennsylvania and New York State district for the Timken Roller Bearing Co., Canton, Ohio. Mr. Lyle has been a sales engineer in the Cleveland district, but will now be located in Buffalo.

JOSEPH H. HUMBERSTONE has been elected a vice-president of Air Reduction Co., Inc., New York City. He was formerly president of the company's Airco Equipment Mfg. Division, and has been succeeded in that capacity by SCOTT D. BAUMER.

PETER A. FRASSE & CO., INC., recently opened a new office and warehouse building in Syracuse, N. Y., on Court Square Road. It will be devoted to the distribution of alloy, stainless, and cold-finished carbon steels and tubing.

HOWARD J. STAGG has been appointed director of training for the Crucible Steel Co. of America, New York City. Mr. Stagg, whose headquarters are in Syracuse, N. Y., has been in charge of the sales training program.

AMERICAN MEASURING INSTRUMENTS CORPORATION announces that the plant and offices of the company have been moved to the new Amic Building, 21-25 Forty-fourth Ave., Long Island City 1, N. Y.

ATLAS CHAIN & MFG. CO., Philadelphia, Pa., has opened a New York City office, at 250 W. 57th St. OLIVER J. R. TROUP, JR., is the district manager in charge.

WALTER G. ENGLER has assumed the duties of general sales manager of the Gifford-Wood Co., Hudson, N. Y., manufacturer of materials-handling equipment.

NORMAN E. CARLSON has been appointed assistant chief mechanical engineer of the American Car & Foundry Co., New York City. For eight years prior to this appointment, Mr. Carlson was connected with the Great Northern Railway.

Ohio

JOHN L. FULLER, technical coordinator in the engineering department of the Reliance Electric & Engineering Co., Cleveland, Ohio, has been promoted to the newly created post of manager of research and technical services.

DON S. SMITH, general production manager of the Wellman Bronze & Aluminum Co., Cleveland, Ohio, has been appointed vice-president in charge of production.

Don S. Smith, newly appointed vice-president in charge of production of Wellman Bronze & Aluminum Co.

Warren G. Rosendahl, assistant general manager, Hamilton Division, Clearing Machine Corp.

WARREN G. ROSENDAHL has been named assistant general manager of the new Hamilton, Ohio, division of the Clearing Machine Corporation. Mr. Rosendahl was formerly an officer of the Hamilton-Thomas Corporation, from which Clearing recently purchased the plant it now occupies in Hamilton.

ORAL T. CARTER & ASSOCIATES, INC., 1704 Dreman St., Cincinnati 23, Ohio, announces that the company is manufacturing a complete line of conveyor equipment and machinery which will be known as Carter "Black Velvet" conveyors. The trade name is derived from the fact that the working parts of Carter conveyor wheels and rollers are treated with a deep penetrating oil, which insures lubricated operation and provides rust preventive qualities.

ROBERT E. COOK, field engineer at Cleveland, Ohio, for the Timken Roller Bearing Co., has been named sales engineer of the Steel and Tube Division at the Cleveland office. He has been associated with the company since 1939.

R. B. BLYTHE has been appointed executive chief engineer of the Aro Equipment Corporation, Bryan, Ohio. The position of sales manager of the Aircraft Division, vacated by Mr. Blythe, will be filled by J. R. MARKEY.

SHEPHERD SPECIAL MACHINE & DIE CO., announces that it is enlarging its plant at 15215 Chatfield Ave., Cleveland, Ohio.

MALLORY-SHARON TITANIUM CORPORATION announces the removal of its general offices from Indianapolis, Ind., to Niles, Ohio. The titanium melting furnace now located in Indianapolis is also being moved to Niles.

New Books and Publications

INCENTIVE MANAGEMENT. By James F. Lincoln. 280 pages, 6 by 9 inches. Published by the Lincoln Electric Co., 22801 St. Clair Ave., Cleveland 17, Ohio. Price, $1 in United States; $1.50 elsewhere.

An important phase of the management problem is discussed in this book. Here is presented a philosophy by means of which workers and managers in business and industry can develop themselves as skillful individuals and work together cooperatively for everyone's benefit. The author believes that the mainspring of the development of skill is incentive, and that the fundamental incentive is recognition of that skill and the results it achieves in higher pay, greater output, and lower prices. How to develop the latent abilities of men and direct them toward the production of "better and better goods at lower and lower prices for more and more people" is the thesis of this book. The philosophy is based on the success of the incentive system of management established by the Lincoln Electric Co., an outline of which is given in the appendix.

Among the practical points discussed are the following: How to install an incentive system; piecework in industry; why incentive systems fail; security and the role of the Government in providing it; the place of the union; the efficient and correct size for a business, and how to finance the company.

A NEW APPROACH TO ENGINEERING TOLERANCES. By J. Gilson. 99 pages, 5 1/2 by 8 1/2 inches. Published by the Machinery Publishing Co., Ltd., National House, West St., Brighton 1, England. Sold in the United States by THE INDUSTRIAL PRESS, 148 Lafayette St., New York 13, N. Y. Price, $2.

In this book, the author points out the great importance of establishing realistic tolerances rather than setting unduly restricted ones that do not permit an economic balance between quality and quantity of output. It is believed that a systematic investigation should be made of the many factors affecting tolerances and the degree of fit of engineering products. This can be done by collating the practical experience of designers, production engineers, and inspectors on fits and tolerances. The experience of one production engineer is given in this book.

The subject matter presented applies particularly to the interchangeable manufacture of light engineering products, but the basic principles are applicable to all production processes. The contents cover the following subjects: General tolerances for various production processes; effect of tolerances on fits; effect of tolerance accumulation on assemblies; method of expressing tolerances on drawings; and standard limit and fit systems.

THE MAKING, SHAPING, AND TREATING OF STEEL. By J. M. Camp and C. B. Francis. 1435 pages; 713 illustrations. Published by United States Steel Corporation and sold by United States Steel Co., 525 William Penn Place, Pittsburgh 30, Pa. Price, $7.50; to schools and colleges, $5.

Scientific advances in the steel industry during the last ten years are fully covered in the sixth edition of this treatise on steelmaking. Descriptions of standard processes have been revised to bring them up to date, and new information has been added. Technological progress during the last decade covers the development of new rugged steels for World War II, faster steelmaking methods, and a revision of steel compositions to conserve alloying elements.

Experts and authorities in each steelmaking field have contributed to the preparation of the book. There are thirty-eight chapters, sub-divided into sections. The index, which contains more than 23,000 items, covers 148 pages. The chapter that is probably most representative of the great strides made by the industry in the last ten years is that covering the principles of heat-treatment of steel.

A.S.M.E. MECHANICAL CATALOG AND DIRECTORY (1952). 675 pages, 8 1/2 by 11 inches. Published by the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

This is the forty-first annual volume of a catalogue covering hundreds of items used by industry in manufacturing its products and in maintaining its plants. It is intended to supply the practicing engineer with a guide to the sources of supply for all the equipment and materials he may need.

There are three main sections of the book. The catalogue section shows illustrations and gives important data on the products made by various companies, arranged in alphabetical sequence according to the name of the manufacturer. The second section is a classified directory of products in the mechanical engineering field, arranged alphabetically according to the product. It gives the names and addresses of the manufacturers, and covers all of the products shown in the catalogue section. The third section contains an alphabetical list of trade names of the products made by the manufacturers listed.

INDUSTRIAL FURNACES. By W. Trinks (Fourth Edition). 526 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price, $10.

This is the first volume of a comprehensive work dealing with the design, construction, and operation of industrial furnaces. Following an introductory section in which the use of furnaces, general description and classification, and the elements of furnace construction are considered, the book discusses heating capacity of furnaces; fuel economy; heat-saving appliances, with particular reference to industrial furnaces; strength and durability of furnaces; and movement of gases.

The new edition contains many changes and improvements. It incorporates the most recent facts that research has discovered about heat transfer and furnace design, as well as present-day design and operating techniques.

AIR-OPERATED PRODUCTION AIDS. 64 pages, 5 1/2 by 8 1/2 inches. Published by the Machinery Publishing Co., Ltd. National House, West Street, Brighton 1, England. So d in the United States by THE INDUSTRIAL PRESS, 148 Lafayette Street, New York 13, N. Y. Price, 75 cents.

This little book describing air-operated clamps, jigs and fixtures, and other work-shop devices used in production and assembly is No. 2A of the well-known Yellow Back Series. It presents a selection of compressed air applications employed by a number of manufacturing companies, and indicates the economies that can be achieved by the use of air equipment.

1950 SUPPLEMENT TO SCREW-THREAD STANDARDS FOR FEDERAL SERVICES, 1944. 113 pages. Published by the Government Printing Office, Washington 25, D. C. Price, 50 cents.

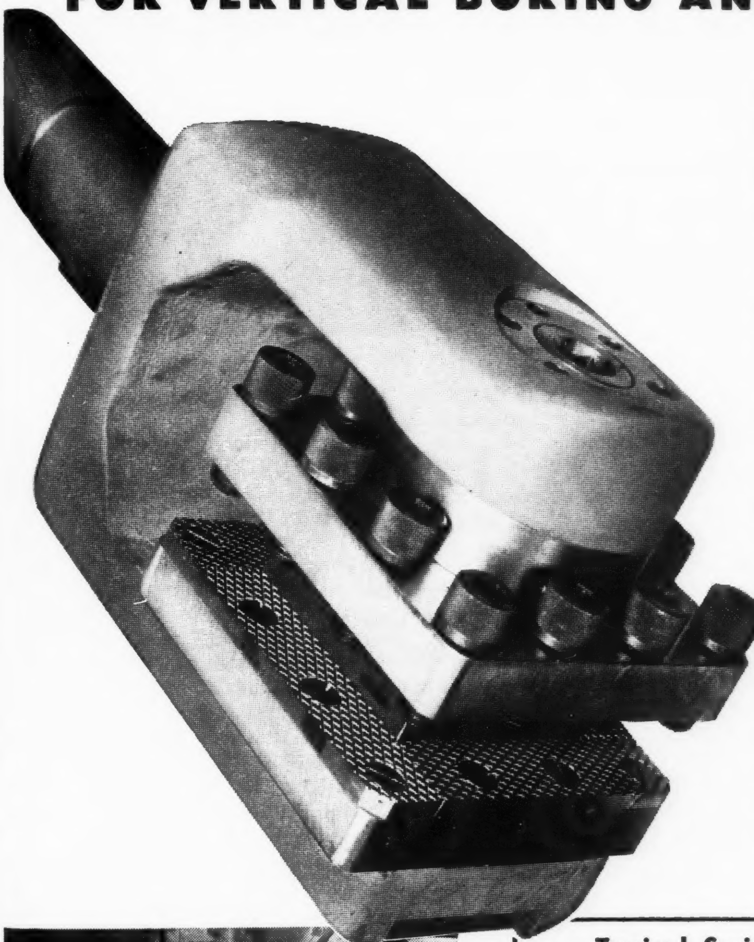
This 1950 supplement to the National Bureau of Standards Handbook H28 makes available the revised American screw thread standards, known as Unified standards, approved for federal services. In addition, it contains special threads and American National diameter-pitch combinations not yet recognized as Unified standards, but for which allowances and tolerances have been formulated in accordance with the principles of Unified threads.

EXTERNAL PIPE THREADS. 21 pages, 8 1/2 by 11 inches. Published by the Reed Rolled Thread Die Co., Worcester, Mass. Price, 75 cents.

Condensed and simplified data on external taper and straight pipe threads, prepared by the company from various standards, is presented

ANNOUNCING A NEW 8 POSITION TOOL HOLDER

FOR VERTICAL BORING AND TURNING MILLS



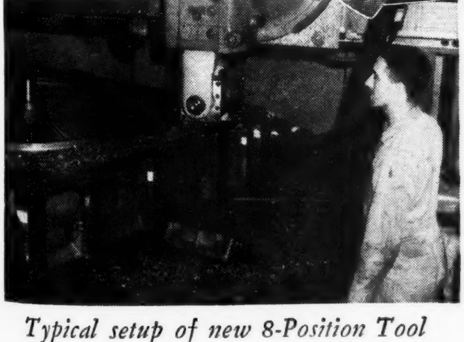
One Simple Wrench Adjustment to Change Position

Indexes Accurately Through 360° in Increments of 45°

You'll save more setup time than was ever before possible with the new Davis 8-Position Tool Holder.

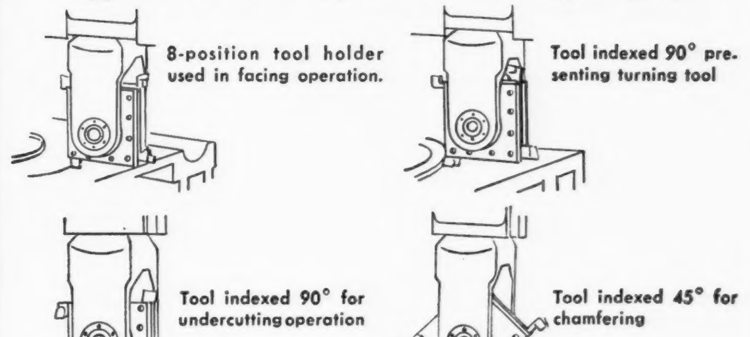
In one setup, you can turn, undercut, bore and chamfer. You can mount 4 tools at once. Tools are then positively positioned with 2 index pins. Cast steel body assures accuracy. One simple wrench adjustment will change your position through 360° in accurately indexed increments of 45°. A center pin locks the complete assembly in rigid alignment and clamps it solidly.

Here's an advanced development that solves the old-time problem of numerous setups. Plan now to increase your production with your present equipment. Call your nearest Davis representative or write us direct about the new Davis 8-Position Tool Holder.



Typical setup of new 8-Position Tool Holder on a large vertical boring mill. For operation details, see the sketches at the right.

Typical Series of Operations on Single Setup



DAVIS BORING TOOL

Division of GIDDINGS & LEWIS MACHINE TOOL COMPANY • Fond du Lac, Wisconsin

World's Largest Builder of Horizontal Boring, Drilling and Milling Machines • Planer-Type Milling Machines • Large Vertical Boring Mills

here. In addition to general information and formulas, tables of tolerances, diameters and lengths, clearances, and thread form specifications are given.

PHOTOELASTIC STRESS ANALYSIS. 16 pages, 5 1/2 by 8 1/2 inches. Published by the Eastman Kodak Co., Rochester 4, N. Y. Price, 35 cents.

DOLLAR SAVINGS THROUGH STANDARDS. 32 pages, 8 1/4 by 11 1/4 inches. Published by the American Standards Association, 70 E. 45th St., New York 17, N. Y. Price, $1.

This booklet contains the report of a comprehensive survey of the savings effected in the machine tool and other industries by the use of standards. It includes 140 case studies covering 81 industries and products.

Brazing in Salt Baths

THERE is a growing trend toward the use of liquid salt baths for brazing because of the many inherent advantages of this process, according to the E. F. Houghton Co. Any ferrous or non-ferrous metal that can be brazed and any type of bonding alloy may be used in the proper salt bath at the correct temperature for each process. The advantages of salt brazing may be listed as follows:

1. Temperature control is held to plus or minus 5 degrees uniformly throughout the bath, thus avoiding distortion.
2. Multiple assemblies can be brazed in a single batch.
3. Salt baths heat work from four to six times faster than radiation type furnaces. Heat transfer is by conduction only. Time of immersion is usually less than two minutes, which speeds up production.
4. Selective heating is possible by immersing only the section to be brazed without heating the entire assembly.
5. The salt, itself, protects against scaling or decarburization, during both the brazing and cooling. The thin film of salt which adheres to the surface upon removal is cleaned off readily in the quench or rinse.
6. No flux is required for copper or brass brazing.
7. Casehardening can be performed at the same time as brazing by using a carburizing bath as the heating medium.

Salt baths are most economical when used in production work. If brazing is done only at infrequent intervals, the power cost and idling time might make this method more expensive. Salt baths are not recommended where there are blind joints at which salt collects and will not drain off.

Houghton's Liquid Heat 110, recommended for copper brazing, has proved satisfactory in brazing joints and sections simultaneously in a matter of minutes. This has been applied to parts that go into the making of fine-mesh filters used in jet aircraft with satisfactory results.

The former method was to solder two sides of a filter and then place it in a heavy bronze cage for support. Salt bath brazing has completely eliminated the need for the cage. Thus the cost of the filter has been reduced, and the process has proved far superior to the previous method.

The copper brazing takes place in a bath of Liquid Heat 110 at 2050 degrees F. This is followed by a water quench, then a pickle in 20 per cent hydrochloric acid, adding a little Cerfak 1300 to give the acid solution faster wetting action. The pickle is not used to remove oxides or scale, but to dissolve completely any salt remaining in the fine mesh. Finally, the parts are rinsed and neutralized in a solution of our Houghto-Clean 217.

* * *

H. W. Gillett Memorial Lecture Established by ASTM

The American Society for Testing Materials has announced the establishment of an annual H. W. Gillett Memorial Lecture. The purpose of this lecture, which is being sponsored by the Society in cooperation with the Battelle Memorial Institute, Columbus, Ohio, is to commemorate Horace W. Gillett, one of America's leading technologists and first director of the Battelle Institute. The lecturer, who will be selected through a committee appointed by the ASTM board of directors, will cover a subject pertaining to the development, testing, evaluation, and application of metals.

* * *

High-Speed Motion-Picture Photography

A 16-millimeter sound motion picture has been produced by the Eastman Kodak Co. to demonstrate the ability of a high-speed picture camera to "magnify time." With a camera of this type, any movement or action that is too fast for the eye to follow can be slowed down so as to be readily studied. The film is available on loan without charge from the Eastman Kodak Co., Rochester 4, N. Y.

Obituaries

Norman Mellor

Norman Mellor, senior partner of the Arguto Oilless Bearing Co., Philadelphia, Pa., died on November 4 at his home in Germantown, Pa., at the age of eighty-two years. Mr. Mellor was born in Philadelphia and educated at the Eastburn Academy. In the early 1890's, he began experimental work on the modern storage battery while associated with the Globe Gas Light Co., and was directly responsible for some of the basic patents on the lead storage battery. From 1894 to 1896, he was employed by Thomas Edison, during which period he did research work on the incandescent lamp. In 1896, he founded the Arguto Oilless Bearing Co.

Mr. Mellor developed and manufactured the Ankyra anchor bolt—the original type of expansion bolt used in hollow walls—and also did development work on an electrical distributor for internal combustion engines, several of the basic features of which were incorporated in the ignition systems of the modern gasoline engine. Since 1900, Mr. Mellor devoted himself almost exclusively to the Arguto business. He is survived by his wife and three sons, Norman, Jr., James M., and Harrison Clay.

OSCAR A. KNIGHT, retired Detroit district manager of the Grinding Machine Division of the Norton Co., Worcester, Mass., died on December 17 at his home in Royal Oak, Mich., aged seventy-two years. He was born in Worcester on October 1, 1879.

JOHN R. MCDONALD, president of the Peerless Machine Co., Racine, Wis., died on November 10.

Coming Events

JANUARY 14-17 — PLANT MAINTENANCE SHOW and PLANT MAINTENANCE CONFERENCE at Convention Hall in Philadelphia, Pa. Further information can be obtained from Clapp & Poliak, Inc., 341 Madison Ave., New York City.

JANUARY 31-FEBRUARY 1—Midwinter Technical Meeting of the AMERICAN SOCIETY FOR METALS at the William Penn Hotel, Pittsburgh, Pa. National secretary, W. H. Eisenman, 7301 Euclid Ave., Cleveland 3, Ohio.

FEBRUARY 9-MARCH 24 — INTERNATIONAL INDUSTRIAL MACHINERY EXPOSITION in Delhi, India. Further information can be obtained from Consulate General of India, 3 E. 64th St., New York 21, N. Y.

MARCH 3-7—Spring meeting of the AMERICAN SOCIETY FOR TESTING MATERIALS at the Hotel Statler, Cleveland, Ohio. Executive secretary, C. L. Warwick, 1916 Race St., Philadelphia 3, Pa.

MARCH 11-14—Fifth NATIONAL PLASTICS EXPOSITION, sponsored by the Society of the Plastics Industry, Inc., to be held at Convention Hall, Philadelphia, Pa. Further information can be obtained from Langdon P. Williams, director of public relations, 67 W. 44th St., New York, N. Y.

MARCH 17-21—Ninth Biennial Industrial Exposition of the AMERICAN SOCIETY OF TOOL ENGINEERS at the International Amphitheatre, Chicago, Ill. Harry E. Conrad, executive secretary, 10700 Puritan Ave., Detroit 21, Mich.

MARCH 22-APRIL 6—Second CHICAGO INTERNATIONAL TRADE FAIR at the Navy Pier, Chicago, Ill. For further information, write to Executive Vice-president John N. Gage, Colonel U. S. A. (Ret.), Merchandise Mart, Chicago 54, Ill.

MAY 1-7 — International Foundry Congress and Show at Convention Hall, Atlantic City, N. J. Sponsored by the AMERICAN FOUNDRYMEN'S SOCIETY, 616 S. Michigan Ave., Chicago 5, Ill.

MAY 22-24 — Sixth annual convention of the AMERICAN SOCIETY FOR QUALITY CONTROL at the Onondaga County War Memorial, Syracuse, N. Y. Further information can be obtained from the Society, Room 5036, 70 E. 45th St., New York 17.

JUNE 23-27 — Fiftieth anniversary meeting of the AMERICAN SOCIETY FOR TESTING MATERIALS at the Hotels Statler and New Yorker in New York City. Further information can be obtained from the executive secretary, C. L. Warwick, 1916 Race St., Philadelphia 3, Pa.

* * *

New Association of Bearing Specialists

A new trade organization known as the Association of Bearing Specialists has been incorporated under the laws of the state of Illinois. The membership includes concerns whose primary purpose is supplying ball and roller bearings to the industrial trade for maintenance. The officers of the organization are as follows: Chairman of the board, William F. Chase, president of the Bearing Service Co., Pittsburgh, Pa.; president, J. R. Gelomb, president of the Iowa Bearing Co., Davenport, Iowa; vice-president, Gene Tappero, president of the Michigan Bearing Co., Detroit, Mich.; and secretary, W. S. McClendon, Behrings Bearing Service Incorporation, Houston, Texas.

Work Blades for Centerless Grinding

Various materials may be used for the work-support blades of centerless grinding machines, according to "Grits and Grinds," published by the Norton Co. Cemented-carbide faced blades are most commonly employed on large-production, through-feed operations, as the life of such blades is usually considerably greater than that of blades constructed of other materials. Gray cast-iron or high-speed steel blades are also widely used, but they are more generally employed for plunge-grinding. The reason for this is that, in plunge-grinding, the shape of the blades may be changed quite frequently, and these materials are easier and more economical to reshape.

In grinding some materials, it may be difficult to prevent loading or fusing of chips to the work blade, even though the coolant used is high in lubricity. This tends to produce scratching or tearing of the work surface. When fine finishes are desired, this may cause rejection of the work-pieces. To eliminate such conditions, the blade working surface should be of a material that is softer than the material being ground, so that the blade with be scratched rather than the work. Brass-tipped blades have been found to be most satisfactory for this purpose. When extremely fine finishes are desired and fine-grit wheels are used, it has been found that blades topped with leather or rubber are effective in that they do not scratch the work.

In general, centerless grinding is done with work blades having an angular top because of the rounding effect this offers. In using an angular-topped blades, if a low spot should come in contact with it, the work drops slightly and more material is removed from the high spot, so that a true cylindrical shape is produced.

Howard W. Easton, machine assembler at the Pangborn Corporation, Hagerstown, Md., manufacturer of blast cleaning and dust control equipment, receives a gold watch from Thomas W. Pangborn, president, at the first annual dinner of the company's Quarter-Century Club. Seventy-seven other employes having over twenty-five years service were similarly honored. Mr. Easton is a veteran of thirty-seven years with the firm, the second oldest employe in length of service. Victor F. Stine, vice-president, is first, having a record of thirty-nine years. Seated next to Mr. Pangborn is Dr. Kenneth McFarland, guest speaker. Dr. McFarland is educational consultant and public speaker for General Motors Corporation. Two hundred and seventy-eight other employes—all having over ten years service—joined in the festivities.